AGE ESTIMATION FROM FUSION OF ECTO CRANIAL (Coronal, Sagittal, Lambdoid, Temporal) SUTURES IN HUMANS – A STUDY IN BODIES DURING AUTOPSY TO PROVE / DISPROVE AGES OF SUTURAL CLOSURE USED IN ROUTINE PRACTICE.

Dissertation submitted for partial fulfilment

of the requirements for the degree

M.D. (Forensic Medicine)

BRANCH – XIV

DEPARTMENT OF FORENSIC MEDICINE,

TIRUNELVELI MEDICAL COLLEGE,

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THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY,

CHENNAI.

APRIL 2015.

BONAFIDE CERTIFICATE

This is to certify that the work undertaken in this dissertation entitled "Age estimation from fusion of ecto cranial (Coronal, Sagittal, Lambdoid, Temporal) sutures in humans – A study in bodies during autopsy to prove / disprove ages of sutural closure used in routine practice" has been carried out by Dr.Manivasagam.M, M.B.B.S., a Post Graduate student under my supervision and guidance for his study leading to Branch XIV M.D. Degree in Forensic Medicine during the period of June 2012 to May 2015.

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DECLARATION

I, Dr.Manivasagam.M, M.B.B.S., solemnly declare that this dissertation titled "Age estimation from fusion of ecto cranial (Coronal, Sagittal, Lambdoid, Temporal) sutures in humans – A study in bodies during autopsy to prove / disprove ages of sutural closure used in routine practice" is a bonafide work done by me, under the expert guidance and supervision of **Dr.A.Selvamurugan.,MD., DNB., MNAMS.,** Associate Professor & Head of the Department of Forensic Medicine, Tirunelveli Medical College, Tirunelveli – 11. This dissertation is submitted to The Tamil Nadu Dr. M. G. R. Medical University towards partial fulfilment of requirement for the award of M.D. Degree (Branch XIV) in Forensic Medicine.

Place:

Date: **Dr.Manivasagam.M.**

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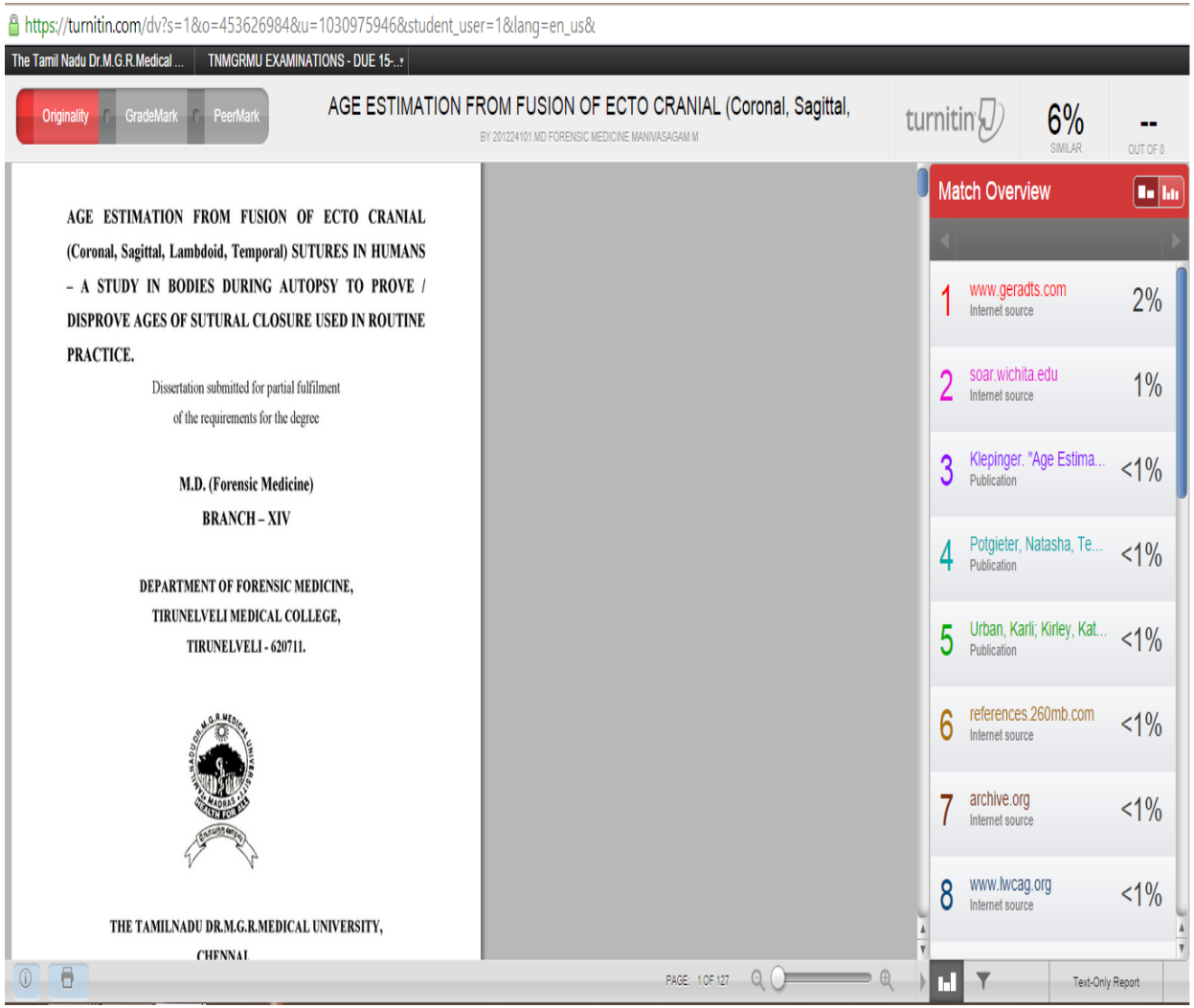
ABBREVATIONS

&	-	And
<	-	Lesser than
>	-	Greater than
%	-	Percentage.
C	-	Coronal Suture
CF	-	Completely fused
Cr. No	-	Crime Number
C/o	-	Care of
D/o	-	Daughter of
Ed.	-	Edition
F	-	Female
F/o	-	Father of
H/o	-	Husband of
L	-	Left (at suture staging)
L	-	Lambdoid Suture
Ltd	-	Limited
IBM	-	International Business Machines
i.e.	-	That is
j	-	Journal

M/o	-	Mother of
n	-	Number of subjects
NF	-	Not fused
No	-	Number of cases
M	-	Male
p	-	Probability significance
PASW	-	Predictive and analysis software
PM No.	-	Post Mortem Number
P. S	-	Police Station
R	-	Right
S	-	Sagittal Suture
SB	-	Sutural Bones
S.D	-	Standard Deviation
S.E	-	Standard Error
SPSS	-	Statistical Package for Social Sciences
Sl. No	-	Serial number
S/o	-	Son of
T	-	Temporal Suture
W/o	-	Wife of

ANNEXURE I: Turnitin similarity Certificate



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This is to certify that the Institutional Ethical Committee of this College unanimously approves the Thesis /Dissertation/ Research Proposal submitted before this committee by Dr.M. Manivasagam, PG in Forensic Medicine, Department of Forensic Medicine, Tirunelveli Medical College /Hospital, Tirunelveli titled **"AGE ESTIMATION FROM FUSION OF ECTOCRANIAL SUTURES(CORONAL, SAGITTAL, LAMBDOID AND TEMPORAL) IN HUMANS- A STUDY IN BODIES DURING AUTOPSY TO PROVE/DISPROVE AGES OF SUTURAL CLOSURE USED IN ROUTINE PRACTICE"** registered by the IEC as 278/FM./IEC/2012 dated. 14.12.2012. The Investigator is hereby advised to adhere to all the stipulated norms and conditions of this ethical committee.

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Ethical Committee,
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Age estimation from fusion of ecto cranial sutures (Coronal, Sagittal, Lambdoid and Temporal) in humans – A study in bodies during autopsy to prove / disprove ages of sutural closure used in routine practice.

Abstract:

Estimation of age of an individual is one of the interesting areas in Forensic Medicine. There are many age estimation techniques in practice. But, most of the techniques can be applied only in a narrow age group. Age from suture closure is a technique of age estimation that can be applied to wide age groups between 18 to 80 years. This study is about estimating age at death of a person from the ecto cranial suture closure status in local population between 30 to 80 years. Individuals selected in this study are with known age (identity proofs). Result obtained is analyzed and compared with accepted standard.

Key words: Age estimation, Ecto cranial suture, comparison.

INTRODUCTION:

Identification is one of the foremost and interesting sectors in Forensic field. If individuality of a person is conclusively established, it becomes complete or definitive identification. If the points of individuality are pointing towards but not concluding, it becomes an incomplete or partial identification. Age, sex and ancestry are called primary characters of identification; in this age at death of a person or skeletal remains becomes a matter of issue as in civil or criminal responsibilities of a person; validity of contract, marriage and consent; kidnapping, prostitution; old age benefits etc. Age at death finds its importance as corpus delicti, particularly with an increasing trend towards effacement of identity or in identifying an unknown person.

With increasing tendency of crime perpetrators towards effacement of identity, either by acts of commission (dismembering, decapitation, burning post mortem, dumping in water sources) or by intentional neglect of killed on less habited dwellings end up with partly skeletonized remains of deceased reaching us for our expertise. To listen to the bones for answers, Skull is the most widely studied human skeletal structure because of its relatively higher resistance to environmental and animal destruction than other bones and hence techniques based

on skull for age estimation are widely studied till date.

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From Forensic point of view these properties of durability of skull with its resistance, hard to get destroyed by animal disinterment are of immense value in cases of advanced decomposition, fire, mass disasters as an identification tool.

There are many techniques for estimating age at death of a deceased person. This may include hair color and complexion, physical development like primary and secondary sexual characters, tooth eruption pattern and even the number of carpal bones (between the age of 2 to 7 years) on simpler means. Cranial sutural closure pattern, tooth examination by Gustafson`s technique modified by Johanson, lines of increment on teeth as devised by Boyde`s, Stack`s method of age estimation, epiphyseal appearances and their fusion with their primary centers or bone shafts, diaphyseal length, thyroid cartilage ossification by Cerny, morphology of sternal end of 4^{th} rib, changes in symphysis pubis, recent trends of relating acetabular sharpness and porosity as age indicator in adults and racemization of aspartic acid in bones and cartilage are also helpful in estimating the approximate or probable age at death of a deceased.

Age related changes are coherent and occur in a defined age limit that is exact and more reliable in early years of life. This is not so with later years of life,

as there are number of factors like wear and tear to pose difficulty and thus less precision in age estimation.

This error can be better solved by combining several of these age estimation techniques. Further, physiological adulthood ranges from the third decade through the tenth; this extent between the decades adds another bias to our techniques. This issue of overestimating the age of young adults and under estimating the aged crops up. Bias tends to shift on overestimation of age in case of young or shifts on underestimating the age of aged persons. But in middle years, this bias is said to be overcome or with equal probability of positive and negative biases on either side.

In skull, regarding dentition as an age estimating tool, eruption pattern applies to newborn (temporary dentition) and to early years of life (permanent dentition). Gustafson's method may be used in later parts of life but with increasing errors with increasing age. Other morphological traits such as sutural closure pattern, surface appearance of vault (granular & muscle markings), Pacchionian depressions on either side of Sagittal sinus and radiological methods to visualize vascularity of diploe, skull thickness are the possible age estimation techniques using skull.

Of these methods using skull, most would not give an age related progressive change to be applied to group persons into various age divisions. For example, smooth ivorine skull of young is replaced by a skull with prominent muscle markings that of an adult.

It is not possible for many of these techniques to define age groups but only above or below limits can be said. To conclude, all these techniques would only have application in estimating a narrow spectrum of age group.

Sutural closure pattern is one of these age estimating techniques that is commonly adopted in our day to day medico legal practices. It is by far one of the common age estimation studies from bones that are being undertaken. It has the benefit of involving a wide range of age groups. This method can involve recording of sutural obliteration as a whole or at specific points as studied by Meindl and Lovejoy [(1)] or by devising a regression equation as done by Nawrocki [(2)].

Studies are being undertaken not only on vault sutures but also to include sutures like palatine suture, maxillary sutures [(3), (4)].

Advent of computer technologies has revolutionized our field of forensic studies by exploring every detail of individual sutures and whole bone by X rays, CT imaging, laser scanning and processing [5].

Further, sutural closure pattern is the only possible age estimation technique applicable with extensive studies in age group from 30 years to 80 years.

Skull sutures are easier to identify and record even in decomposed bodies or in skeletal remains. In skull, ecto cranial suture and endo cranial suture closure are appreciated as two different entities. Endo cranial sutures are earlier to fuse than ecto cranial sutures. They tend to close 5 to 10 years in advance to their ecto cranial counter parts. Hence, fusion of sutures (endo cranial) is comparable and correlated to symphysis pubis age estimation techniques (between 18 to 60 years of age) [6].

To involve age limits between 30 and 80 years, age estimation technique from ecto cranial suture closure by naked eye examination is selected. Of various parameters that could affect closure of sutures like sex, climate and ethnicity, this study is aimed at estimating age at death of persons with known age from their ecto cranial sutural closure pattern at autopsy and comparing it with accepted standards.

A cross sectional study with 500 cases from 30 to 80 years of age of both sexes is selected from the bodies received for medico legal autopsies in Tirunelveli region and their ecto cranial suture closure pattern is studied.

AIM OF THE STUDY

Aim & Objectives:

To find ages of ecto cranial suture fusion in different age groups in male and female sexes of local population.

To compare the results obtained with that of various works on ages of ecto cranial suture fusion.

To prove / disprove ages of ecto cranial suture closure used in routine practice in correlation with local population.

Justification for study:

Present times, we are following same ages of ecto cranial suture closure pattern in our medico legal works in many parts of India. Being a vast nation, with so many geographical, ethnical and nutritional determinants to influence this suture

closure age pattern, it is prudent to consider the biological and natural variations. So, studies with respect to local populations can be carried out.

Hence, ages at which ecto cranial sutures fuse are studied and analyzed with a sample of local population that reaches our Medical College Hospital and subsequently to our College mortuary for autopsy.

Methodology:

Assess ages of ecto cranial suture closure pattern during autopsy on bodies with known age from 30 to 80 years at death.

Risks:

No risk of mutilation of bodies.

No risk to the examiner.

Has institutional ethical committee clearance obtained for this study?

Yes.

Outcome:

May prove or disprove the practicing standards of ages of fusion of ecto cranial sutures in our medico legal works.

Benefits:

To carry out medico legal works with more efficacy and certainty.

National Significance:

If the ages of ecto cranial suture closure is proved, we shall continue using the same standards that are routinely practiced in our medico legal works.

If it is disproved, extensive work shall be further undertaken in varied conditions so as to formulate population specific or region specific age standards in this perspective.

REVIEW

OF

LITERATURE

Review of literature:

Dwight (1890) noted that suture closure begins endo cranially, and arrived at a conclusion that “the time of closure of any particular part of a suture, and the order in which the process advances, are very uncertain. And the process is later in females”.

Parsons and Box (1905) stated that closure “is later in females and also simple sutures (less serrated or denticulated) closed earlier. No differences between right and left sides were noted”.

Bolk (1915) suggests that physiologic obliteration of the sutures may be an atavistic trait. Since the suture in the ape closes as soon as the skull is fully grown.

Pittard and Kaufmann (1936) found no racial or right left differences in skull sutural closure.

Montagu (1938) quotes that Vesalius and his student Fallopius first noted the obliteration of sutures with age.

Glaister (1947) mentions that the absence of any sign of closure of any of the sutures of the skull points to a strong probability that the age does not exceed thirty years. The closure of Sagittal, Coronal and Lambdoid sutures has unusually begun by the age of thirty. The Parieto Mastoid and squamous suture commence at a later stage between thirty five and fifty years but do not show great advancement until between fifty and sixty years.

BRASH, J. C. in Glaister and Brash's Medico Legal Aspects of Ruxton Case considers 'total absence of closure is unlikely after 30 years of age. The

Sagittal, Coronal and Lambdoid sutures normally begin to close at from 20 to 30 years, followed about 5 years later, by the onset of closure of parieto mastoid and squamous sutures, which, however, may remain open or only incompletely closed at 60; the spheno parietal suture does not usually close until the age of 70'.

SIR SYDNEY SMITH AND FREDERICK SMITH FIDDES (1949) in their treatise on Forensic Medicine write 'the sutures of the skull become obliterated, a condition first observed on the internal aspect. They further write about beginning of closure as 'usually beginning at the obelion (on Sagittal suture), and closure may be quite marked by the age of forty (years of age). Closure of the lambdoid suture is usually not complete before fifty years (of age), and the masto – occipital, squamous and parieto - mastoid is at very old age.

> Regarding its variations in respect to age and reliability they noted that the range must lengthen; and after thirty years, when the mature skeleton already begin to show signs of "ageing" – including the beginning of progressive closure of the cranial sutures. It will be hardly safe to estimate more closely than in decades. The absence of any sign of closure of any of

the sutures of the skull points to a strong probability that the age does not exceed thirty years.

Cobb (1952) stated that age assessment from cranial sutures is not reliable because it “probably approximates the true age of an individual within plus or minus nine years”.

McKern and Stewart (1957) stated that Ecto cranial sutural closure is highly variable and only broadly be correlated with age. In the Sagittal suture (25 % of 55 skulls) for example, closure had already begun in 17 – 18 years of age and had become very common in 31 – 40 years of age (90 % of 43 skulls).

Francis Camps (1968) writes “From the forensic stand point this is very different from saying, as formerly that the sagittal suture begins to closure at 22 years and completes its closure at 35 years. It is better, therefore, not to rely on the sutures in skeletal age determinations”.

Ascadi and Nemeskeri (1970) on their study concluded sex was not found to be a factor in the process of sutural change.

In his book ESSENTIALS OF FORENSIC ANTHROPOLOGY, T.D. STEWART (1979) Quotes Cobb ‘that there is some general or constitutional influence which modifies progress in suture closure, commencing approximately at thirty years, is evident since all sutural elements, whatever

their degree of union, show arrested activity at this age. While bone along a suture edge is still in a state of active change it possess a granular texture difficult to describe but easy to recognize. After activity has ceased the granularity gives place to a waxy smoothness of texture. Heaped - up edges on an unclosed suture are characteristic evidence of quiescence which absolutely differentiates the suture from one still in a state of active closure. Todd called this condition lapsed union’.

Shapiro (1981) writes that sutures begin to close on both the outer and inner aspects of the calvarium at about the same time. Ecto cranial fusion proceeds somewhat more slowly showing more individual variation.

Zivanovic (1983) recorded that left and right sides of the coronal and lamdoid sutures, both endocranially and ectocranially on East African Bantu skulls. Pars Bregmatica and pars complicata of the coronal suture and pars intermedia of Lambdoid suture were the most assymetrical. Asymmetry was common in both population and sexes. He adds that if asymmetry is noted it should be considered as pre mature synostosis not be discarded from age estimation.

It is common between 41 and 50 years.

Baker (1984) found that asymmetry is predominantly observed between 36 to 40 years and 61 to 65 years of age. In general symmetry is predominant over asymmetry.

Perizonius (1984) analyzed both ectocranial and endocranial sutural closure in a sample of 256 males and 20 females. He did not observe any sex difference in the speed of the closure.

Parson, Gee and Knight (1985) mentions that the last suture to close is the spheno parietal suture which may still be open in old age, even after 70 years. They add open sutures are often found and they are a menace in finding age from suture closure pattern. Hence, suture closure has guarded applicability in age estimation. It is much helpful in assessing age at death of skeletal remains particularly if the remains are fragmentary.

Meindl RS, Lovejoy CO (1985) on their study on Ecto cranial suture, followed a method by reading cranial suture closure at points of Cranial suture in mid Lambdoid, lambda, obelion, anterior Sagittal, bregma, mid coronal, pterion, spheno frontal, inferior spheno temporal, superior spheno temporal.

Mann et al. (1987) documented that males typically exhibit more suture obliteration at all ages than do females, but that race has only a minor influence on this parameter.

Snow (1982) says that in his case series all sutures of a 101 year old male have been found to be still completely open and at the other extreme, skull of a 22

year old man has been found to exhibit completely fused sutures to show its erratic nature in closure.

Iscan M. Y. and Kennedy K. E. R. (1989) quote McKern and Stewart that the progress of suture closure has only a general relationship with age in their work Reconstruction of life from Skeleton.

Massler & Schour (1991) studied osteoblastic accretion along the suture lines as an indicator of bone growth and suture closure in their work on ‘Maxillary suture obliteration – A visual method for estimating skeletal age’.

Dr. Krishnan MKR (1992) on his work Medico legal Necropsy states that fusion age for sutures are as follows, Posterior 1/3rd Sagittal: 30 – 40 years, middle 1/3rd Sagittal: 50 – 60 years, anterior 1/3rd Sagittal: 40 – 50 years, upper ½ of Coronal: 50 – 60 years, lower ½ Coronal: 40 – 50 years, upper ½ of Lambdoid: 50 – 60 years, lower ½ of Lambdoid: 60 -70 years and Temporal: 80 years.

MALLIK CC, (1993) writes suture closure as estimation tool can be used with caution. The result obtained would place an individual in decades. There is no male and female difference. Various environmental factors can modify the suture closure. It starts to close on inner table of skull followed by outer table. Ecto cranial sutures start 5 to 10 years after endo cranial sutures. It takes further 20 to 40 years to fuse completely.

In a book edited by Mehmet Yasar Iscan and Richard P. Palmer FORENSIC ANTHROPOLOGY OF THE SKULL (1993) Novonty et al writes ‘Scores for each site noted (in skull) were added by region and plotted against ages. Ages calculated for composite scores from the five lateral anterior sutures which were found to have the best correlation with age’.

Kanisius and Luke (1994) reported ancestral biases were found to be significant between Europeans and Australian Aborigines, and research which reports austosomal dominant and recessive patterns of premature suture closure patterns.

Key et al (1994) tested cranial suture closure on known age individuals from the sixteenth century crypt of Christ Church, and reported great variability in suture closure, so that only broad age categories could be identified. They found that advanced suture closure of the inner table of skull was complete by 50 years of age and there by useful only at ages younger than that. The ectocranial sutures displayed pattern and age variability between males and females.

Moreover, they found out that open ecto cranial sutures could be found in all age groups with about equal frequency and so could not be taken as evidence of youth or younger individual.

Buikstra and Ubelaker (1994) on their text ‘Standards for Data Collection from Human Skeletal Remains’ described suture closure scoring system as Score 0 – Open, 1 – Minimal closure, 3 – Significant closure, 4 - Completely obliterated.

M1. Mestri SHASHIDAR C., (1994) writes Posterior 1/3rd Sagittal: 30 – 40 years of age, middle 1/3rd Sagittal: 50 years of age, anterior 1/3rd Sagittal: 40 –

50 years of age, upper ½ of Coronal: 50 – 60 years of age, lower ½ Coronal: 40 – 50 years of age, upper ½ of Lambdoid: 50 – 60 years of age, lower ½ of Lambdoid: 60 -70 years of age.

H1. Hershkowitz et al (1997) observed the following on closure of sutures:

(1) closed (TC);

2) partially closed (PC): less than 10% of the suture length was open;

3) totally open (TO): the suture line was clearly visible with almost no

interruptions along its entire length. Minor closure at the area of the parietal foraminae was ignored;

4) partially open (PO): between 10% and 90% of the suture length was open; and 5) premature suture closure (PMSC).

He concludes that suture obliteration patterns are independent permanent phenomena; some are genetically inherited and the relative frequency of the ‘‘totally open’’ category is higher in females.

His study also introduces a new name ‘Double Y suture – where sagittal suture is completely closed and coronal, Lambdoid remain open’.

SIMPSON's Forensic Medicine by Bernard Knight edition (1997) "The cranial sutures tend to fuse with age. But it is too variable to be of any practical use".

DAS B.M. and DEKA RANJAN (1998) write 'it is possible to suggest the approximate age on the basis of obliteration of sutures. But, it is a fact that many changes occur in the skeleton including the skull with age. For example, with the advancement of age obliteration of the suture of cranial vault takes place on the outer surface between forty and fifty'.

About the starting of sutural obliteration, 'the lower part of the coronal suture is the first to exhibit obliteration, next comes the posterior part of the sagittal suture, to be followed by the lambdoid suture'.

Peggy Thomas in his book FORENSIC ANTHROPLOGY – The Grading Science Of Taking Back (2000) writes 'the squiggly lines on the skull where the bones meet are called cranial sutures. To date the age of a person at death using the skull, specific segments of the suture are assigned and given a score from 0 to 3. Zero indicates that the suture is open. One indicates that it is partially

closed (less than 50 percent). A score of two means that it is more than 50 percent closed and a score of three indicates that the suture is fully closed. They are added and compared to established standards. For example, a score of 11 correlates with an age range of 24 to 60 years with a mean age of 35.4.

The Sagittal suture on the top of the head, running from front to back, fuses by age 35. The coronal suture at the front of the skull, from temple to temple, fuses by age 40.

Schiel Rebecca quotes White and Folkens' (2000) method of grading cranial sutures which involves giving scores to the degree of suture closure at 17 points on the skull. Each site is assigned a score between 0 – 3, and calculating a composite score to assign a corresponding age range. Open sutures are considered with a site score of 0. A score of 1 equates to minimal sutural closure. Significant closure is given score 2, and complete fusion or obliteration is given a score of 3.

Thus this method gives two age ranges. Average age can be calculated using both of these mean ages and the age range is the average of the standard deviation for both estimated ages.

Taylor's Principles and Practice of Medical Jurisprudence edited by Keith Mant (2000) says "For many years, the closure of the skull suture was considered the most accurate method. Recent works has shown that there is too much variation in closure times to merit the use of this method in forensic work".

Rogers and Allard (2004) observed the partial obliteration of sutures in older adults in about 3.5% of the population.

Sahni et al (2005) worked on age assessment from cranial suture closure from Northwestern India sample containing 538 males and 127 females. A total of 665 individuals were in the sample. Sutures were recorded only as "open" or "closed". Sahni and coworkers found earlier obliteration in males than in females; obliteration is so erratic to be used for estimating age. Since previous research (by author) concluded long bone epiphyses fuse earlier in Indians than in western Countries, but not the same pattern in cranial suture closure.

David Dolinak, Evan W. Matshes, Emma O. Lew (2005) write Age – dependant differences in suture closure (ossification of the sutural ligaments) have been used for years in age estimation. Studies of the ecto cranium have the potential to under estimate age.

Nawrocki and Zambrano (2005) reported at the American Association of Physical Anthropology that based on the results of an analysis of variance, there are significant differences in the rate and/or pattern of the suture closure between the sexes and among the ancestral groups.

Klepinger (2006) endorses Nawrocki's idea of individual regression formula for sagittal, coronal, squamous and palatine sutures to make the method more reliable and as the method of choice for this purpose (Age estimation), pending further study.

Rao Nagesh Kumar G (2007) writes in his Practical Forensic Medicine that Posterior 1/3rd Sagittal: 30 – 40 years; anterior 1/3rd Sagittal, lower ½ Coronal: 40 – 50 years; middle 1/3rd Sagittal, upper ½ of Coronal: 50 – 60 years.

PV Guharaj and MR Chandran (2009) in their text on Forensic Medicine write "it occurs (suture closure) externally in the following order: posterior third of the Sagittal suture at about 30 – 40 years of age, anterior third of Sagittal and lower half of the Coronal at about 40 – 50 years of age and middle Sagittal and upper half of coronal at about 50 – 60 years of age. The Temporo parietal sutures close much later".

Further in a "diagram showing approximate ages of closure of sutures of cranial vault, Lambdoid – 50 – 60 years, 60 – 70 years" is mentioned.

In the book, THE USE OF FORENSIC ANTHROPOLOGY, Robert Pickering and David Bachman (2009) mentions age at death as one of the Ten Key questions in skeletal survey. They add suture close or fuse in a relatively consistent pattern and this pattern can give an age range. The problem is that this range is quite broad and provides only an estimate rather than a definite age.

Shetty (2009) on his work on cranial sutures concludes ‘though, there is some difference in suture closure in males and females, it is not significant statistically. There is some statistically significant correlation suture closure up to 40 years of age. Then, they appear to close independently of each other. There is no significant variation in suture closure of right and left sides of coronal and lambdoid sutures, both ectocranially and endocranially. Complete closure (mean value > 3.5) never occurred in ectocranial sutures’.

Parikh (2010) in his work Medical Jurisprudence for Courtrooms and classrooms writes “The closure starts with the Sagittal (30 – 35 years of age), Coronal (35 – 40 years of age), and Lambdoid suture (45 – 50 years of age - variable),

followed by parieto mastoid & squamous sutures (55 – 60 years of age), and the spheno parietal suture which closes by about 70 years.

The palate suture closes at 45 – 50 years.

Pillay V. V., (2010) states that Age evaluation by this method (ecto cranial suture) is generally not accurate, since it can only provide a range in decades.

The usual sequence is for the sagittal suture to close by 30 – 40 years of age (posterior 1/3rd), 40 – 50 years of age (anterior 1/3rd) and 50 – 60 years of age (middle 1/3rd), followed by Coronal suture which fuses between 40 – 50 years of age (lower part) and 50 – 60 years of age (upper part), and temporal suture (around 60 years of age).

Suture closure occurs a little later in females than in males.

Rao Nagesh Kumar G. (2010) writes "the scheme of ossification of skull by suture closure as Sagittal (posterior 1/3rd: 40 – 50, middle 1/3rd: 50 – 60, anterior 1/3rd: - years), Coronal (upper half: - years, lower half: - years), Lambdoid (upper half: - years, lower half: - years), Temporal (years).

Alexandra B. Millard (2011) in his work concludes there are no sex and ancestral variation in suture closure. He further emphasizes the importance of photographic recording of suture closure and its pattern.

Bardale Rajesh (2011) writes “No difference exists between right and left sides of skull. No sex difference in fusion of suture. Sagittal fuses at 30 – 40 years, Coronal 40 – 50 years, Lambdoid 40 to 50 years, Squamous >80 years.

Umadethan B (2011) in his book Forensic Medicine mentions “ anterior Sagittal 40 – 50 years, middle Sagittal 50 – 60 years, posterior Sagittal 30 – 40 years, lower Coronal 40 – 50 years, upper Coronal 50 – 60 years, Lambdoid 50 – 70 years, Temporal – 80 years.

Vij Krishan (2012) writes “Fusion of sutures occurs comparatively early in males. In many skulls, fusion of sutures at the ecto cranial surface may remain incomplete. This is called lapsed union and occurs most often in the sagittal suture.

On the outer side, fusion occurs in the following order,

- Posterior one third of Sagittal suture at about 30 – 40 years,
- Anterior one third of Sagittal and lower half of Coronal at about 40 – 50 years,

- Middle Sagittal and upper half of Coronal at about 50 – 60 years,
- In the Lambdoid sutures, fusion activity starts late and the progress is also slow. The closure starts around 25 – 30 years near the asterion, and the peak of maximum closure occurs at about 55 years.

  Estimation of age by suture closure is not reliable. It can be given only in the range of a decade. The usual reliability falls in the order of Sagittal, Lambdoid and then the Coronal".

Chandrasekaran on his work on Cranial Sutures as an identification tool comments that the skulls of monozygotic twins do contain similar pattern but considerable variations are noticed in the details of the suture pattern.

> It seems that the suture pattern in skulls like finger prints is controlled through inheritance. That even the maximum possible loading by inheritance is found to be insufficient to contract the random

> production of minute variation in the details of suture pattern.

DEROBERT and FULLY based on study of 480 skulls established the unreliability of estimating the age by status of closure of the cranial suture.

They considered it a criterion of value but the criteria is one which must be interpreted... ‘Avec la plus grande prudence’ (with most prudence).

FRANCHINI examined 629 skulls and found that there was no closure of sutures in four of them despite the fact that the subjects were aged, respectively, 45, 48, 55, and 74 years of age.

Singhal mentions that Sagittal suture (between two parietal bones) – obliterates at 30 – 35 years. Coronoid suture (between frontal & two parietal bones) obliterates at 35 to 40 years. Lambdoid suture (between occipital & two parietal bones) obliterates at 45 – 50 years. Squamous suture (between frontal, parietal & temporal bones) obliterates at about 60 years.

An approximate estimate of age of an adult can be obtained. The degree of closure of the three main suture of vault of the skull is divided into 4/5 stages. But even then the accuracy of estimation of age lies at +/- 10 years.

Dr. Akilesh Pathak reports a case of 12 – 14 year old boy with complete fusion of ecto cranial and endo cranial sutures in his paper ‘Contradictory Skull and Age Estimation’.

MATERIALS

AND

METHODS

MATERIALS AND METHODS

Subjects are selected at random from the bodies we received for medico legal autopsies during the study period. This study comprises 500 subjects with known age at death. Ages from 30 to 80 years of both sexes are included, as the suture closure starts at 30 and above years on the ecto cranial side.

Subjects are grouped into decades starting from 30 to 40 years, 41 to 50 years, 51 to 60 years, 61 to 70 years and 71 to 80 years.

Age at death is taken from the post mortem requisition, Case history, Form: 86 details given by the Police / Magistrate depending upon the cases. Valid age proof issued by the Government like Aadhar card, Driving license, Marriage certificate, Passport, Ration card, Voter's ID, Government employer ID cards or any Government / Quasi Government recognized documents are taken for age at death. Preference is given to the identity proofs with date of birth. Age at death from the identity proofs are rounded off to the nearest year.

A careful scrutiny is done on the analyzing work period to look for age mismatch with one document to the available other documents and also for cases with change of crime numbers on subsequent dates due to typing errors or wrong entries.

Though rare, instances of age, name and crime number changes pose difficulty with data collection.

Study design:

Cross sectional study.

Methods:

To read the cranial suture closure or fusion one can rely on naked eye examination after reflecting the tight periosteal layer on outer table of skull. This simpler technique can also be complimented by 2D & 3D CT techniques, X-rays [(5)], laser instrumentation and Osteoblast accretion along suture lines [(3)]. Skeletal age by radiological methods is advanced than direct anatomical methods in age estimation. Hence, radiological examination of skeletal systems would yield an early detection and accurate finding. Even though, radiological methods are more accurate and reliable, direct anatomical observation is preferred in many cases owing to the following reasons: Radiological examination is not preferred in large sample studies, living individuals face the danger of radiation exposure, cost – benefit analysis from the receiver's side, and radiographs plays the role of an intermediary object on which opinions are given while direct examination has no

such drawback where opinions are based on direct examination facts. Further, in our country post mortem radiographs for research and study purposes is less practicable.

Researchers on the other hand support direct anatomical studies than radiological methods, if direct examination is possible. Krogman writes "follow

the bones rather than radiographs which are shadows of what you want to see''. In case of dead, direct examination of ecto cranial sutures is easier and more preferred when compared to radiographs.

Naked eye examination methodology is selected for this study to assess suture closure pattern on ecto cranial sutures before opening the skull. This methodology has advantages of being easy with simpler modus operandi and noninvasiveness. Direct observation of suture status is possible with this methodology.

A proforma is prepared to collect all relevant information like name, age, sex, post mortem number, police station with crime number, general physical examination findings such as built, height in cm, address, occupation and marriage status of the subjects. Age stated is accepted from any of Government issued or Government authorized certificates. Most age proofs are given with driving licenses, aadhar card and PAN cards.

Some cases are provided with Marriage registration certificate, Baptism certificates, and Service register certificate of uniformed services staffs as identity and age proofs. Marriage status is included as an indicator of a reliable partner or heir to produce age proof.

A judgment given by our Honorable Supreme court of India recognized the inclusion of Third sex in gender columns [7]. As the judgment is passed during the study period of this study, third sex column is added to the proforma in a retrospective manner. Though, the study is aimed at finding any sexual differences in suture closure pattern, male and female sexes are only encountered in the studies. Third sex subjects are not encountered in the study.

Ecto cranial suture closure pattern is studied during the Autopsy procedures on bodies at our Department Mortuary hall. On opening the scalp, with the behind ear mastoid to mastoid incision, soft tissue layer of scalp is retracted on front and back of incision. Retraction to the anterior of incision extends to the level just above super ciliary arch and to the posterior to make the full view of lambdoid suture. This procedure needs further separation of the tightly attached periosteal layer from outer table of skull after reflecting the scalp through the loose areolar

layer from outer table of skull after reflecting the scalp through the loose areolar issue layer of scalp.

For this, sand papers used for rubbing off paint are tried. Wetness is the problem for these kinds of papers and the papers could not be used any further.

Next methodology is with periosteal elevator. An effective method of periosteal removal can be done with this methodology.

Knives are also used for scrapping and peeling the periosteal layer instead or in addition to this methodology. Periosteal layer is scrapped with sharp edge of knife or point scrapped with its tip. Tip scratching is used for finer removal of periosteal layer after gross scrapping.

Periosteal layer is removed with ease in cases of decomposition or treated burns, as this layer is highly vascular, the increased fluid content separates the periosteal layer from underlying outer table of skull. Loosening of tissues in decomposition makes the removal of outer periosteum elegant and complete. In treated burns, soft tissue edema causes loosening of outer periosteal layer from the outer table of skull. But these circumstances are only a few out of total 500 cases.

Two cases in the study are exhumed bodies with known identity. Skulls of those cases are brought to our mortuary, examined and findings recorded.

Decomposition changes causing detachment of the periosteum is very well recognized in these two cases.

Periosteal layer is removed on the vault from frontal eminence to the point of lambda. This removal exposes Sagittal suture completely. Coronal suture is

traced down on either side till its Pars pterica to expose it full. Squamous part of temporal suture on both sides is made visible by clean slicing and separating the temporalis muscle on that area. These three sutures namely, Sagittal Coronal & Squamous can be visualized on the body in its lying down position, viewed from Norma verticalis or Norma lateralis view.

But for exploring Lambdoid suture, the head has to be lifted and made upright as much as possible because rigor mortis of neck muscles would prevent flexion of neck on chest. Or the block placed under the shoulders for autopsy procedure can be raised in such a way that graded height blocks under the body to make more exposure to the region of Lambdoid suture. However, making the neck forcefully flex over the chest is relatively easier to read Lambdoid suture.

Lambdoid suture is traced infero laterally to make visible its Right and Left wings up to the termination of suture at mastoid process. At instances, even after careful and meticulous removal, tight periosteal layer at certain points on a suture would be present.

This might indicate an open suture or fusing suture where periosteal layer dips into it. In those instances, suture closure status at remaining portion of the part of suture examined is taken into account.

Observations are made prior to removal of skull by manual sawing, in view that the force used in removing the skull might damage the suture lines or cause sutures to separate if they are in fusing state. Also, recently fused sutures might open up along their lines of fusion if sufficient force is applied on them. Careful examinations on sutures while removing the skull cap by manual sawing and T piece torsion removal would reveal extension of cut ends into sutural separation in non-union sutures. But in cases of united sutures, the extension would take a different line than that of the intervening suture.

Well-known scaling in skull suture status assessment are as follows:

1. Scaling by Ascadi and Nemeskeri,
2. Scaling by Meindl and Lovejoy and
3. Hershkowitz:

Scaling by Ascadi and Nemeskeri is widely followed because of its reliability. Meindl and Lovejoy scaling is used in point examination of sutures. Hershkowitz scaling is newer among these and widely used in excavations and archeology.

Ascadi and Nemeskeri Scaling of suture closure:

Stage 0 - Open suture. A clear space between adjoining bones is seen,

Stage 1- Incipient suture.

Suture is closed, but visible as continuous, zigzagging line,

Stage 2 - Closure in process.

Suture line becomes thinner, less zigzags and may be interrupted by areas of complete suture,

Stage 3 - Advanced suture.

Only scattered pits remain on location of suture,

Stage 4 - Closed suture.

Suture completely obliterated; even its location cannot be recognized.

This system of scaling is **Modified Perizonius phases (0 to 4) after Ascadi and Nemeske**i system of sutural closure pattern staging [(9)].

This scaling has 5 phases in total.

Meindl and Lovejoy (1985) – Meindl and Lovejoy Scoring System:

Stage 0: Open suture.

There is no evidence of any ectocranial closure at the site,

Stage 1: Minimal closure; some closure has occurred.

This score is given for any minimal to moderate closure, i.e., from a single bony bridge across the suture to about 50 % synostosis,

Stage 2: Significant closure;

There is a marked degree of closure but some portion of the site is still not completely fused,

Stage 3: Advanced closure.

Only pits indicate where the suture is located [(1)].

This is Meindl and Lovejoy scoring system of reading suture closure status at specific points of skull. This scaling has only 4 phases (Ascadi & Nemeskeri – 5 phases)

Hershkowitz scaling:

(1) Closed (Total Closure);

(2) Partially Closed (PC): less than 10% of the suture length was open;

(3) Totally Open (TO): the suture line was clearly visible with almost no interruptions along its entire length.

Minor closure at the area of the parietal foraminae was ignored;

(4) Partially Open (PO): between 10% and 90% of the suture length was open; and

(5) Pre mature suture closure (PMSC) [9].

Among this three systems of scaling, each system has its own advantage. Observations in this study are made on the grounds of the system suggested by Ascadi and Nemeskeri (Modified Perizonius phases 0 to 4) because it is widely used and reliable.

Hence, sutures are read and scaled into Stage 0, Stage 1, Stage 2, Stage 3 or Stage 4 as per this Ascadi and Nemeskeri system of scaling suture closure pattern for all the four ecto cranial vault sutures analyzed in this study.

Stages in this notation would mean,

Score of 0 is given if there is no fusion at all on the examined part of suture.

For Score 1 to 3, maximal score of suture closure in case of different phases with in the observed part of the suture.

Score 4 is given only if there is complete fusion.

Suture closure status is done for,

Sagittal suture:

Anterior 1/3rd, Middle 1/3rd and Posterior 1/3rd,

Coronal Suture:

Right half and Left half of corona. Each half is further divided into Upper ½ and Lower ½ segments,

Lambdoid suture:

Right wing and left wing of lambdoid suture, dividing it further into Upper ½ and Lower ½ segments.

Squamous temporal suture: Right and Left (whole suture).

Suture closure finding is entered with notations used in studies by Ascadi Nemeskeri. The alphabet in capital letter indicates the suture, S – Sagittal, C-

Coronal, L – Lambdoid, T – Temporal suture. Next alphabet is either R for right or L for Left in Coronal, Lambdoid and Temporal sutures. Numbers following the alphabet would indicate the suture fusion stage according to the segments of suture. Sagittal suture will have three numbers, Coronal and Lambdoid will have two numbers and Temporal suture will have only one number.

Example: The notation S 2 1 3 would mean Sagittal suture with its Anterior one third at fusion status stage 2, Middle third at stage 1, Posterior third at stage 3. In case of Coronal and Lambdoid sutures, C R 1 2 would mean Coronal suture – Right half having suture closure stage 1 at upper ½ and stage 2 for lower ½.
L L 1 2 would mean Lambdoid suture left part with its upper half at stage 1, lower half at stage 2. Notation for temporal suture is indicated by T R 1, T L 2 – Temporal suture Right side with stage 1, temporal suture on left side with Stage 2.

In addition to this, incidental findings like colour of the skull, sutural bones with its location, Metopism, healed depressed fractures, a variant of Parietal foraman are also noted with interest.

Sutural closure pattern staging are analyzed statistically with SPSS and Epi Info 7 software.

Sample size

500 cases with known age at death.

Sampling design:

Purposive sampling.

Study design:

Descriptive Study.

Inclusion criteria:

Bodies with known age at death from 30 to 80 years.

Known age at death is obtained from Government issued or Government approved or Quasi Government certificates with date of birth in it.

Exclusion criteria:

Deformed head (Traffic / assault injuries, charred remains),

Congenital anomalies (bony defects),

Nutritional deficiencies (if any demonstrable at autopsy),

Fracture of skull leading onto sutural separation,

Crush injury head or heavy cut injuries to head involving the sutures,

Fracture line extending / crossing sutural line and

Migratory populations (different ethnicity) are excluded. Industrial abundance, harbor vicinity are main attraction to the migratory population. Other issue of different ethnicity interfering with the study is that of tourists who are unfortunately lose their lives while here. Such cases of interference by population other than local population is carefully excluded to maximum possibility.

Study period:

One and a half year

Place of study:

Temple of Surprise - Autopsy Hall,

Department of Forensic Medicine & Toxicology,

Tirunelveli Medical College, Tirunelveli.

Statistical methods involved:

The data collected in this study are analyzed statistically using IBM – SPSS and Epi info 7 software. Variables like mean, standard deviation of fusion age and percentages of cases with suture closure in each age groups are calculated.

ANNEXURE – II: Proforma

Ecto cranial suture closure pattern in bodies at autopsy

(Known age from 30 to 80 y of age at death)

Sl. No. / Case no: Date:

PM No:

Station & Crime No:

1. Name : Mr/Mrs/Ms ------, S/O, D/O, H/O, W/O, F/O, M/O, C/O

2. Age at death from (Corrections at cutoff date:)

Driving license :

Ration card :

Others, if any :

3. Sex : M F Third sex

4. Address :

5. Occupation :

6. Married / Unmarried :

7. General Physical Examination :

a. Built & Nourishment (Poor / Moderated / Well)

b. Height in Cm

8. Suture closure status

Sagittal Suture

Coronal Suture

Right half **Left half**

Lambdoid Suture

Right half **Left half**

Temporal Suture

Right **Left**

Other notable points, if any:

10. Consent: I _____ S/o, D/o _____ have no objection for using these findings, photographs for presenting / publishing for study / research purposes.

Signature of the legal Heir. Signature of the examiner.

Master Chart:

(Ecto cranial suture closure pattern in bodies at autopsy with known age at death from 30 to 80 years)

Serial no.	PM no.	Station & Crime no	Age & Sex	Coronal suture	Sagittal suture	Lambdoid suture	Temporal suture

Stage 0: Open suture (NF),

Stage 1: Continuous line,

Stage 2: Interrupted by complete fusion,

Stage 3: Only pits and

Stage 4: Complete fusion (CF).

RESULTS

AND

ANALYSIS

RESULTS AND ANALYSIS:

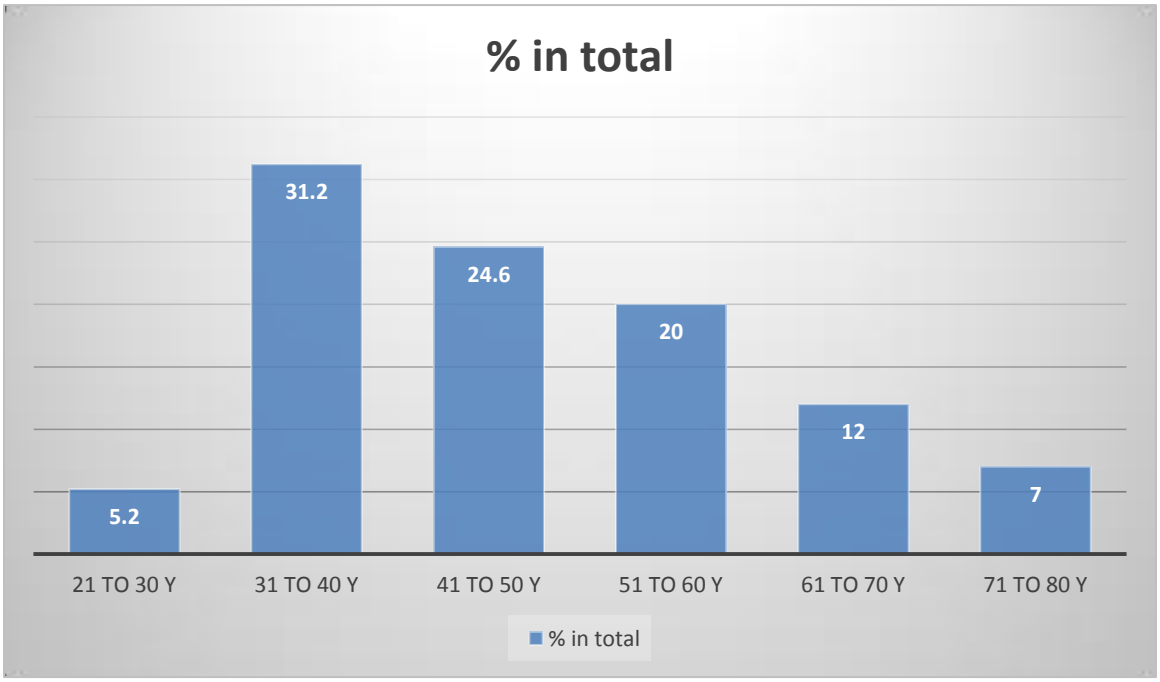
After, completing cranial suture closure status assessment of 500 cases with known age at death, data entered in separate forms are transferred into a master chart. Master chart containing 500 cases is fed into IBM SPSS and Epi Info 7 software for analyzing data. Frequency distribution for data analysis is made as follows:

Table 1: Frequency distribution of cases with respect to age.

Age in completed years	Number of cases	% in total
21 to 30	26	5.2
31 to 40	156	31.2
41 to 50	123	24.6
51 to 60	100	20.0
61 to 70	60	12.0
71 to 80	35	7.0
Total	500	100

During statistical analysis of case details Age group 21 to 30 years constitutes 26 cases out of total 500, this 26 cases comes to 5.2 % of total 500 cases. Similarly, Age group 31 to 40 years constitutes 156 out of 500 cases or 31.2 % of total cases. Age group 41 to 50 years constitutes 123 cases or 24.6 % of total, Age group 51 to 60 years constitutes 100 cases or 20.0 % of total, Age group 61 to 70 years constitutes 60 cases or 12.0% of total 500 cases, Age group 71 to 80 years constitutes 35 cases or 7.0 % out of total 500 cases (Chart 1). Sex wise distribution of cases in each age group is also analyzed.

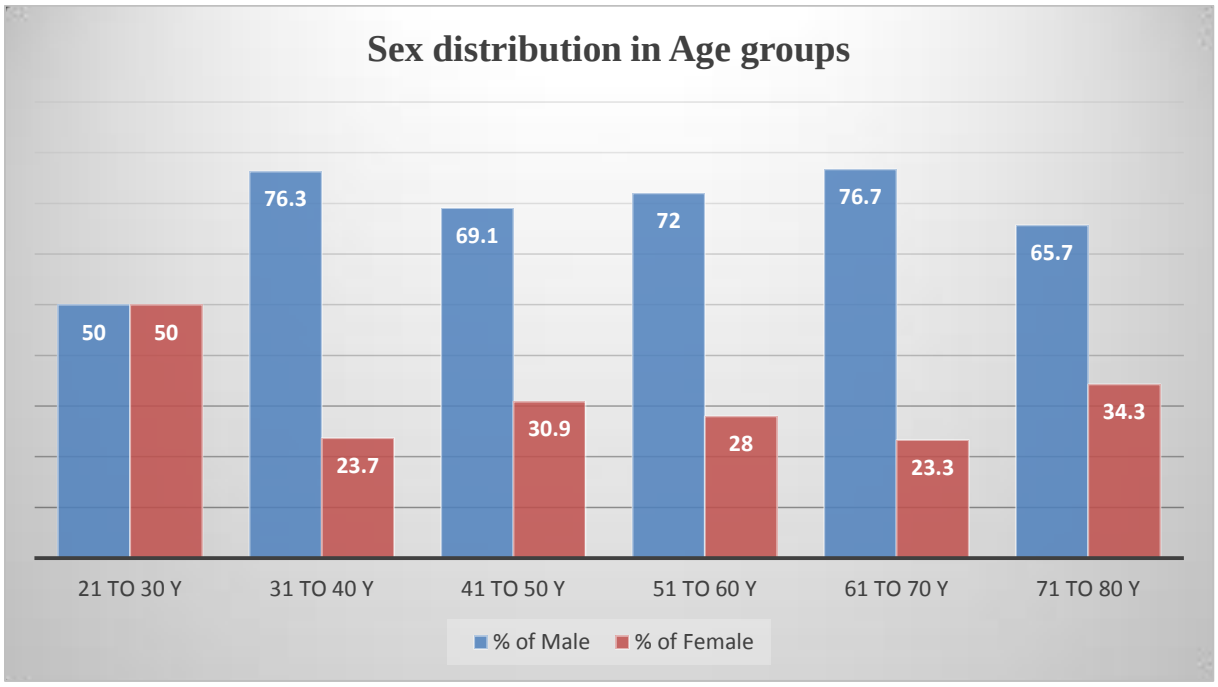
Chart 1: % distribution of cases in various age groups.



In age group 21 to 30 years, 13 0f 26 (50 %) are male, 13 0f 26 (50 %) are female; age group 31 to 40 years has 119 of 156 (76.3 %) male, 37 of 156 (23.7 %) female; age group 41 to 50 years has 85 of 123 (69.1 %) male, 38 of 123 (30.9 %) female; age group 51 to 60 years has 72 of 100 (72.0 %) male, 28 0f 100 (28. 0 %) female; age group 61 to 70 years has 46 of 60 (76.7 %) male, 14 of 60 (23.3 %) female and age group 71 to 80 years has 23 0f 35 (65.7 %) male, 12 of 35 (34.3 %) are female.

This forms a total of 358 of 500 (71.6 %) male and 142 of 500 (28.4 %) female subjects in this study.

Chart 2: Sex distribution in Age groups (in %)



In this analysis, Age group 21 to 30 years is included for analysis purpose. To get parallel and equal Frequency distribution, this type of grouping cases into age groups is adopted. Though the Age group 21 to 30 years contain cases only with age of 30 years, it is named and grouped as Age group 21 to 30 years to achieve Statistical correction and convenience as mentioned above.

Percentage and other statistical values for expected age group 30 to 40 years can be obtained by combining the values in calculated age group 21 to 30 and age group 31 to 40 years. Other age groups are to be read as such.

Analysis are done for individual sutures with their divisions. Statistical variables for Sutures are analyzed under following divisions:

Right wing of Coronal suture's Upper ½ , Right wing of Coronal suture's lower ½, Left wing of Coronal suture's Upper ½, Left wing of Coronal suture's lower ½,

Sagittal Posterior 1/3rd, Sagittal Middle 1/3rd, Sagittal Anterior 1/3rd,

Right wing of Lambdoid suture's Upper ½, Right wing of Lambdoid suture's Lower ½, Left wing of Lambdoid suture's Upper ½, Left wing of Lambdoid suture's Lower ½,

Right Squamous temporal suture and Left Squamous temporal suture.

Right wing of Coronal suture's Upper half:

In the statistical analysis of Upper half of Right wing of Coronal suture,

Age group 21 to 30 years has 26 cases in total by 13 male and 13 female. In male population all 13 are at Stage 0 or in other words all the 13 male in this age group is found to have open suture. Remaining 13 by female population is also at Stage 0 or their suture is open.

Age group 31 to 40 years that constitutes 156 cases out of total 500, has male 119 and female 37 subjects. In 119 male, 106 are at Stage 0 and the remaining 13 are at Stage 1 to 4. In 37 female, 36 are at Stage 0 and only 1 female individual is at Stage 1 to 4. In these analyses Stage 1, Stage 2, Stage 3 and Stage 4 are assigned as Stage 1 for statistical convenience [(S6)]. So, a total of 142 cases at Stage 0 and 14 cases are at Stage 1 when male and female statistics are combined in this age group of 31 to 40 years is analyzed.

In this age group of 41 to 50 years, total 123 cases contain 85 male and 38 female. Of 85 male, 67 are at Stage 0, 18 are at Stage 1 to 4. Of 38 female, 25 are at Stage 0, remaining 13 are at Stage 1 to 4. Combining male and female statistics, we get 92 cases at Stage 0, 31 cases at Stage 1 to 4.

With age group 51 to 60 years having100 cases, 72 are male and 28 are female. 72 male cases has 10 cases at Stage 0, 62 cases with Stage 1 to 4.

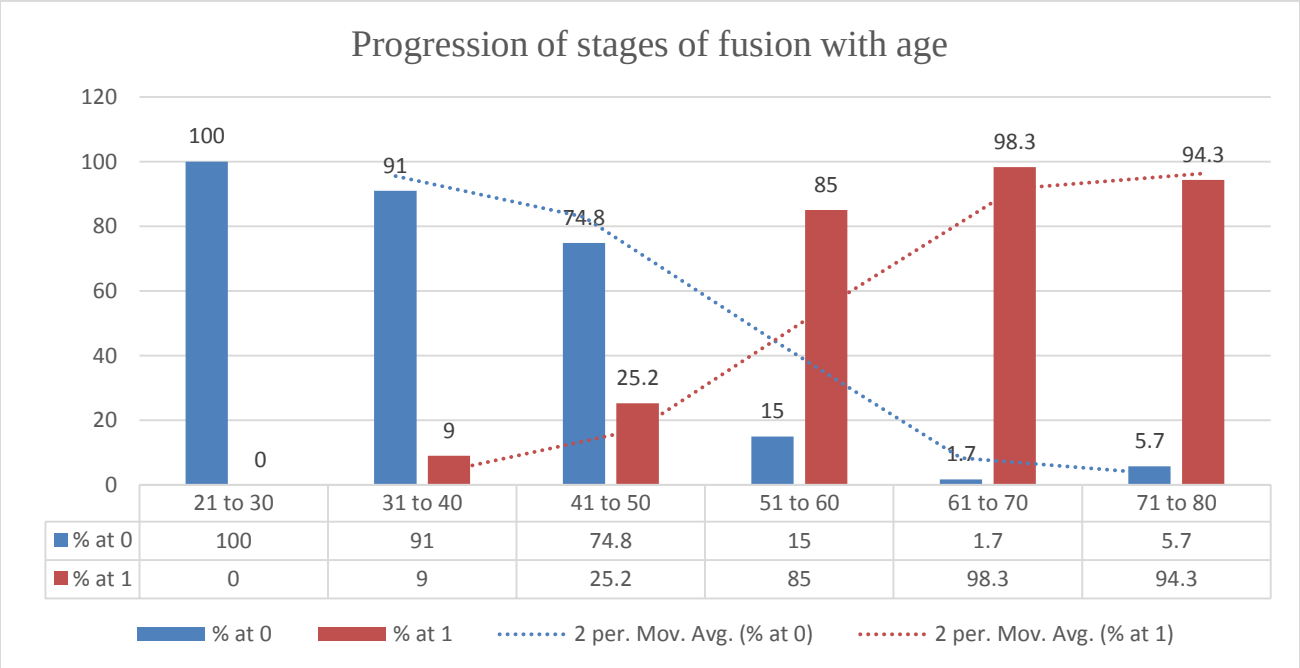
Table 2: Right wing **of Coronal suture's Upper half**

Age group in Years (Sex specific)		CS Upper half – Right side		Total
		0	1	
21 to 30	Male	13	0	13
	Female	13	0	13
	Total	26	0	26
31 to 40	Male	106	13	119
	Female	36	1	37
	Total	142	14	156
41 to 50	Male	67	18	85
	Female	25	13	38
	Total	92	31	123
51 to 60	Male	10	62	72
	Female	5	23	28
	Total	15	85	100
61 to 70	Male	1	45	46
	Female	0	14	14
	Total	1	59	60
71 to 80	Male	1	22	23
	Female	1	11	12
	Total	2	33	35
		278	222	500

28 female cases has 5 cases at Stage 0, 23 cases at Stage 1 or above. So, 15 cases are at Stage 0, 85 cases are at Stage 1 to 4 on male and female combined statistics in this age group.

Age group 61 to 70 years has 60 cases, of which male are 46 and female are 14. Of 46 male, only 1 case is at Stage 0 and the rest of cases (45) are at Stage 1 to 4. Of 14 female, 0 case (no case) is at Stage 0 and so all the 14 cases are at Stage 1 to 4. 1 case at Stage 0 and 59 cases at Stage 1 to 4 is the combined value.

Chart 3: Progression of Stages of fusion with age (CS R Upper 1/2)



Last age group with 71 to 80 years has got 35 cases. Out of this 23 are male and 12 are female. 23 male has 1 individual at Stage 0 and other 22 at Stage 1 to 4.

Among 12 female only 1 is at Stage 0 and other 11 are at Stage 1 to 4. Combining the values we get 2 cases at Stage 0 and 33 cases at Stage 1 to 4.

To summarize, Right side of Coronal suture's Upper half is examined in 358 male and 142 female skulls. Out of 358 male skulls, 198 are at Stage 0 and 160 are at Stage 1 to 4. Out of remaining 142 female skulls, 80 skulls are at Stage 0 and 62 are at Stage 1 to 4. Combining male and female skull statistics we arrive at 278 skulls at Stage 0 and 222 skulls are at Stage 1 to 4 (Table 2). In the Chart 3, we can see the percentage of Stage 0 skull decrease as age increases (blue dotted line) and rise in percentage of Stage 1 skulls as age increases (red dotted line).

Table 3: Statistical variables for Right wing of Coronal suture's Upper half

Stage	N	Mean	SD	SE
0	278	40.12	7.467	.448
1	222	59.62	11.233	.754

Mean obtained for Stage 0 (non-fusion) is 40.12 years, Stage 1 is 59.62 years.

Standard deviation thus calculated is 7.467 for Stage 0 and 11.233 for Stage 1.

Standard error Mean is .448 for Stage 0 and .754 for Stage 1 (Table 3).

Right wing of Coronal suture's Lower half:

In the statistical analysis of Lower half of Right wing of Coronal suture,

Table 4: Right wing **of Coronal suture's Lower half**

Age group in Years (Sex specific)		CS lower half – Right side		Total
		0	1	
21 to 30	Male	13	0	13
	Female	13	0	13
	Total	26	0	26
31 to 40	Male	98	21	119
	Female	34	3	37
	Total	132	24	156
41 to 50	Male	28	57	85
	Female	10	28	38
	Total	38	85	123
51 to 60	Male	6	66	72
	Female	2	26	28
	Total	8	92	100
61 to 70	Male	1	45	46
	Female	1	13	14
	Total	2	58	60
71 to 80	Male	2	21	23
	Female	1	11	12
	Total	3	32	35
		209	291	500

First Age group 21 to 30 years has 13 male and 13 female out of 26 cases. In male population all 13 cases are at Stage 0 (open suture) and 13 cases by female population are also at Stage 0 or their suture is open. So, the number of cases in this age group towards Stage 1 becomes Zero.

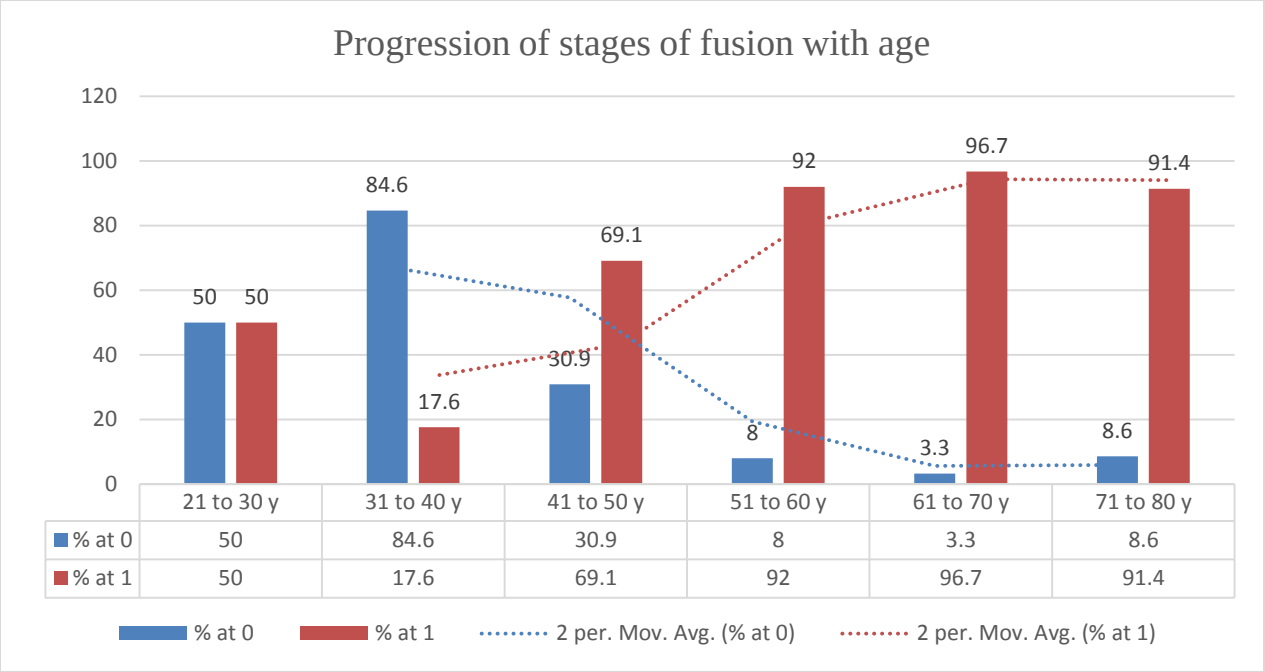
Age group 31 to 40 years that constitutes 156 cases out of total sample of 500, has male 119 and female 37 cases. In 119 male, 98 are at Stage 0 and the remaining 21 are at Stage 1 to 4. In 37 female, 34 are at Stage 0 and only 3 female individuals are at Stage 1 to 4. A total of 132 cases at Stage 0 and 24 cases at Stage 1 to 4 is obtained when male and female statistics are combined in this age group of 31 to 40 years.

In the age group of 41 to 50 years, a total of 123 cases contain 85 male and 38 female. Of 85 male, 28 are at Stage 0, 57 are at Stage 1 to 4. Of 38 female, 10 are at Stage 0, remaining 28 are at Stage 1 to 4. Combining male and female statistics, we get 38 cases at Stage 0, 85 cases at Stage 1 to 4.

With age group 51 to 60 years having100 cases, 72 are male and 28 are female. 72 male cases has 6 cases at Stage 0, 66 cases with Stage 1 to 4. 28 female cases has 2 cases at Stage 0 and 26 cases at Stage 1 to 4. So, 8 cases are at Stage 0 and 92 cases are at Stage 1 to 4on male and female combined statistics.

Age group 61 to 70 years has 60 cases, of which male are 46 and female are 14. Of 46 male, only 1 case is at Stage 0 and 45 cases are at Stage 1 to 4. Of 14 female, 1 case is at Stage 0 and 13 cases are at Stage 1 to 4. 2 cases at Stage 0 and 58 cases at Stage 1 to 4 is the combined value.

Chart 4: Progression of Stages of fusion with age (CS R Lower 1/2)



Last age group with 71 to 80 years has got 35 cases. Out of this 23 are male and 12 are female. 23 male has only 2 subjects at Stage 0 and other 21 subjects at Stage 1 to 4. Among 12 female only 1 is at Stage 0 and other 11 are at Stage 1 to 4. Combining the values we get 3 cases at Stage 0 and 32 cases at Stage 1 to 4.

In summary, Right side of Coronal suture's Lower half has 358 male and 142 female skulls assessed. Out of 358 male skulls, 148 are at Stage 0 and 210 are at Stage 1 to 4. Out of remaining 142 female skulls, 61 skulls are at Stage 0 and 81 are at Stage 1 to 4. Combining male and female skull statistics we arrive at 209 skulls at Stage 0 and 291 skulls are at Stage 1 to 4 (Table 4). In the Chart 4, we can see fall in non-closure status percentage as age advances (blue dotted line) and rise in percentage of fusion Stage in skulls as age increases (red dotted line).

Table 5: Statistical variables for Right wing of Coronal suture's Lower half

Stage	N	Mean	SD	SE
0	209	38.61	8.205	.568
1	291	56.08	11.620	.681

Mean obtained for Stage 0 is 38.61 years, Stage 1 is 56.08 years.

Standard deviation thus calculated is 8.205 for Stage 0 and 11.620 for Stage 1.

Standard error Mean is .568 for Stage 0 and .681 for Stage 1 (Table 5).

These are variables calculated for Right side of Coronal Suture's Lower half.

Left wing of Coronal suture's Upper half:

Left wing of Coronal suture's Upper half is analyzed and found to have same statistical values that of Right side of Coronal suture's Upper half. Distribution of male and female in individual sutures is constant in the study.

Table 6: Statistical variables for Left wing of Coronal suture's Upper half

Stage	N	Mean	SD	SE
0	278	40.12	7.467	.448
1	222	59.62	11.233	.754

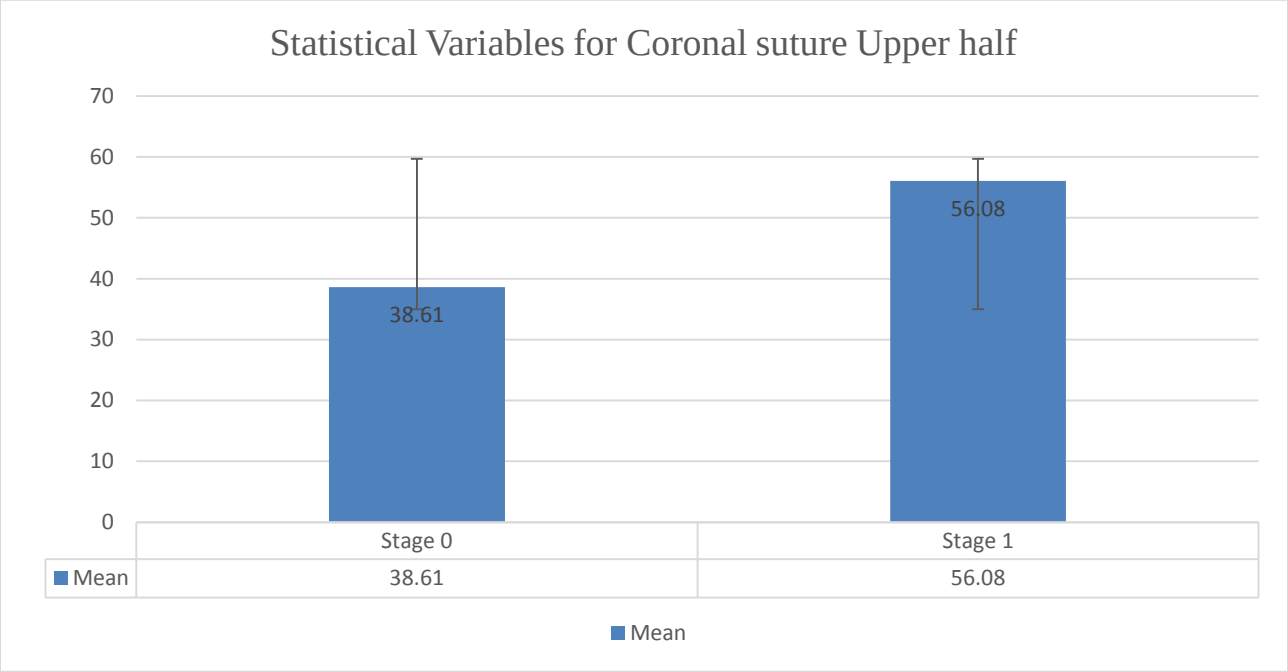
Distribution of number and percentage of cases in Stage 0 and Stage 1 in age groups divided at the starting of analysis is also the same between Right side of Coronal suture's Upper half and Left side of Coronal suture's Upper half (Table 2).

Hence, mean age of fusion for Stage 0, Stage 1; standard deviation, standard error of mean are all the same with Right side of Coronal suture's Upper half (Table 6).

Here, the Chart 5: Statistical variables for Coronal suture Upper half, blue bar with 38.61 mean value belongs to mean age of non-fusion or mean age of Stage 0. A black link line inside and above the blue bar is area for Standard deviation.

Likewise, blue bar with 56.08 mean value belongs to mean age of Stage 1 and the link line on it refers the area of Standard deviation.

Chart 5: Statistical variables (SD) for Coronal suture Upper half.

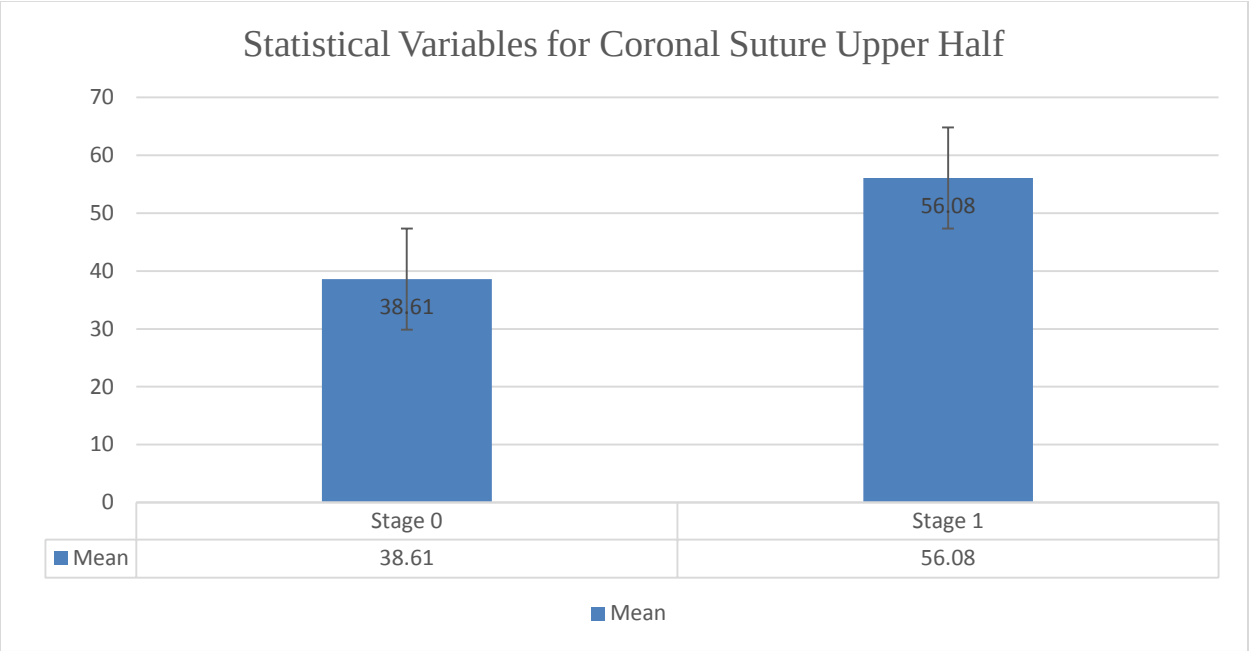


Standard deviation is indicated by black link line

Here, in this Chart 6: Statistical variables for Coronal suture Upper half, blue bar with 38.61 mean value belongs to mean age of non-fusion or mean age of Stage 0. A black link line inside and above the blue bar is for Standard error.

Likewise, blue bar with 56.08 mean value belongs to mean age of Stage 1 and the black ink line on it refers the area of Standard error.

Chart 6: Statistical variables (SE) for Coronal suture Upper half.



Standard error is indicated by black link line

Asymmetry:

Though the variables calculated are one and the same for both sides of Coronal suture's Upper half, there is an element of asymmetry in two skulls. One is No.345, a 75 y male with C R 2 0; C L 1 0 status. Other is No. 462, a 68 y female with C R 4 4; C L 3 4 status. No asymmetry in stage 0 and Stage 1 between the sides is observed.

Left wing of Coronal suture's Lower half:

Like the statistics of Left side of Coronal suture's Upper half in comparison with Right side of Coronal suture's Upper half; Left side of Coronal suture's Lower half and Right side of Coronal suture's Lower half are having same statistical variables (Table 7). The issue of asymmetry here is as follows:

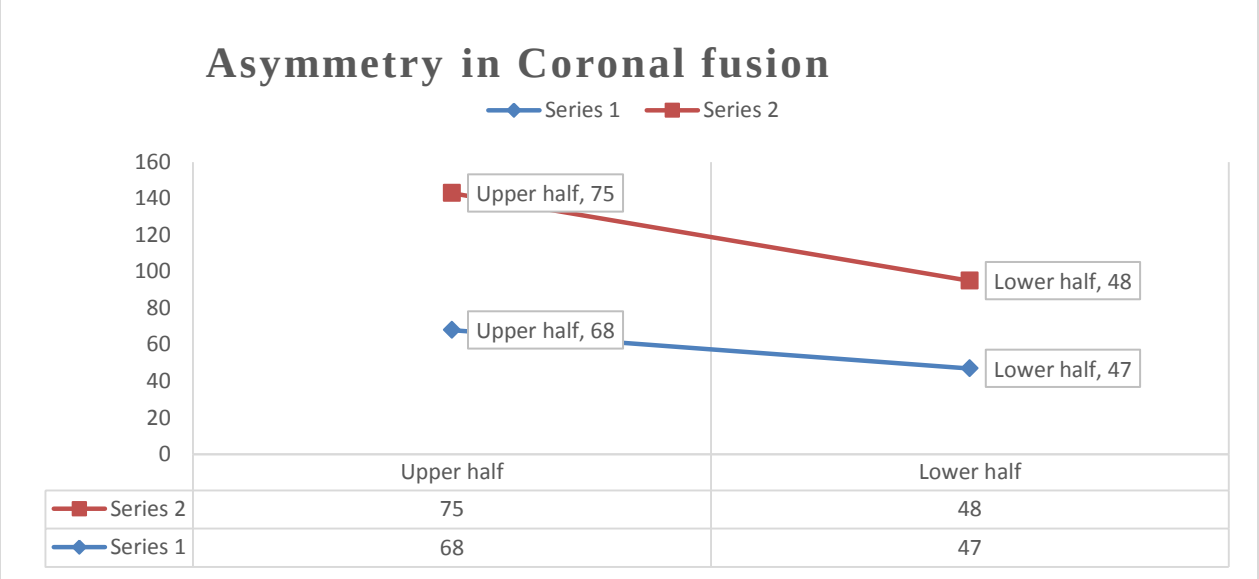
1. No.100, 47/F, C R 0 2 C L 0 1;
2. No. 366, 48/M, C R 0 2 C L 0 1. (Chart 6)

Table 7: Statistical variables for Left wing of Coronal suture's Lower half

Stage	N	Mean	SD	SE
0	209	38.61	8.205	.568
1	291	56.08	11.620	.681

In both Upper and Lower half of Coronal sutures asymmetry between its Right and Left wings, 50 % is by male skull and 50 % is by female skull. Age of asymmetry in upper half is at 75 & 68 years while that of lower half is at 48 & 47 years (Chart 6). This asymmetry in stages above 1 does not alter any statistical variables thus derived, as the Stages 1, 2, 3, 4 are all grouped as Stage 1 for statistics.

Chart 6: Asymmetry in Coronal Suture fusion – Age distribution



Sagittal suture – Anterior one third:

First Age group 21 to 30 years has 13 male and 13 female out of 26 cases. In 13 male all are at Stage 0 and all 13 cases by female are also at Stage 0. So, no case is at stage 1.

Age group 31 to 40 years that constitutes 156 cases out of total sample of 500, has 119 male and 37 female cases. In 119 male, 93 are at Stage 0 and 26 are at Stage 1 to 4. In 37 female, 33 are at Stage 0 and 4 female cases are at Stage 1 to 4. A total of 126 cases at Stage 0 and 30 cases at Stage 1 to 4 is obtained.

In this age group of 41 to 50 years, a total of 123 cases contain 85 male and 38 female. Of 85 male, 20 are at Stage 0, 65 are at Stage 1 to 4. Of 38 female, 8 are at Stage 0, remaining 30 are at Stage 1 or above. Combining male and female statistics, we get 28 cases at Stage 0, 95 cases at Stage 1 to 4.

With age group 51 to 60 years having100 cases, 72 are male and 28 are female. 72 male cases has 4 cases at Stage 0, 68 cases with Stage 1 or above. 28 female cases has 4 cases at Stage 0 and 24 cases at Stage 1 to 4. So, 8 cases are at Stage 0 and 92 cases are at Stage 1 to 4 on male and female combined statistics.

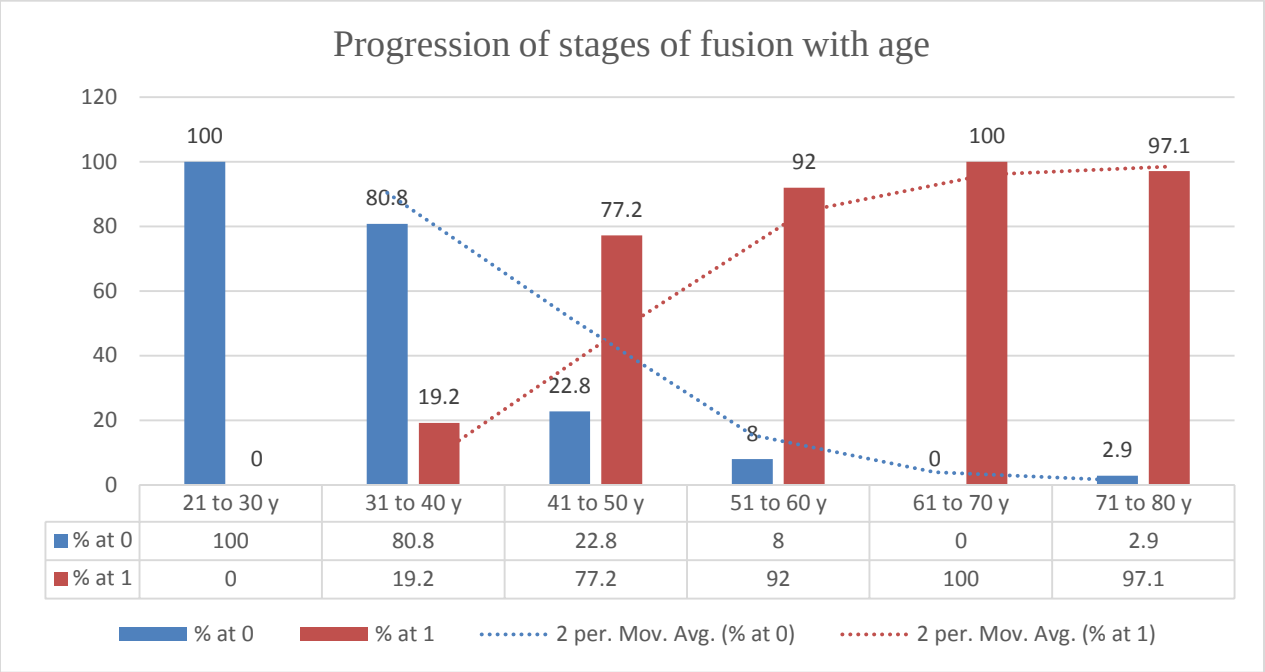
Age group 61 to 70 years has 60 cases, of which male are 46 and female are 14. Of 46 male, no case is at Stage 0 and all 46 cases are at Stage 1 to 4. Of 14 female, no case is at Stage 0 and all 14 cases are at Stage 1 to 4. No cases at Stage 0 and all 60 cases at Stage 1 to 4 is the combined value.

Last age group with 71 to 80 years has got 35 cases. Out of this 23 are male and 12 are female. 23 male has only 1 subject at Stage 0 and other 22 subjects at Stage 1 to 4. Among 12 female no case is at Stage 0 and other 12 are at Stage 1 to 4. Combining the values we get 1 cases at Stage 0 and 34 cases at Stage 1 to 4.

In summary, sagittal suture anterior one third has 358 male and 142 female skulls assessed.

Out of 358 male skulls, 131 are at Stage 0 and 227 are at Stage 1 or above. Out of remaining 142 female skulls, 58 skulls are at Stage 0 and 84 are at Stage 1 to 4. Combining male and female skull statistics we arrive at 189 skulls at Stage 0 and 311 skulls are at Stage 1 to 4. In the Chart 7, we can see fall in non-closure status percentage as age advances (blue dotted line) and rise in percentage of fusion Stage in skulls as age increases (red dotted line).

Chart 7: Progression of Stages of fusion with age (SS Anterior 1/3)



Progression of fusion status with advancing age

Mean value for Stage 0 is 37.34 and for Stage 1 is 55.72. SD for Stage 0 is 6.530 and for Stage 1 is 11.713. SE comes to .475 for Stage 0 and .664 for stage 1.

Sagittal suture – Middle one third:

Age group 21 to 30 years has 13 male & 13 female. All cases are at Stage 0.

Age group 31 to 40 years that contributes 156 cases out of 500, 119 male and 37 female cases are present. In 119 male, 111 are at Stage 0 and 8 are at Stage 1 to 4. In 37 female, 35 are at Stage 0 and 2 female cases are at Stage 1 to 4. A total of 146 cases at Stage 0 and 10 cases at Stage 1 to 4 is arrived at.

In this age group of 41 to 50 years, a total of 123 cases contain 85 male and 38 female. Of 85 male, 70 are at Stage 0, 15 are at Stage 1 to 4. Of 38 female, 34 are at Stage 0, remaining 4 are at Stage 1 to 4. Combining male and female statistics, we get 104 cases at Stage 0, 19 cases at Stage 1 to 4.

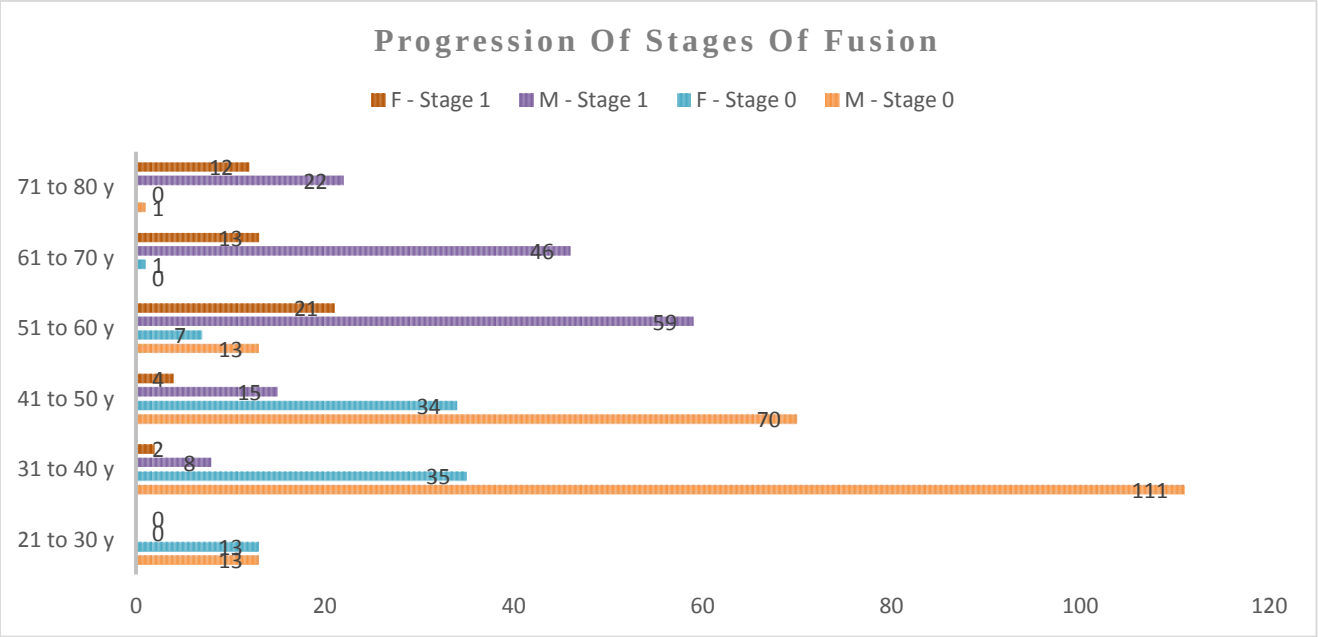
With age group 51 to 60 years having100 cases, 72 are male and 28 are female. 72 male cases has 13 cases at Stage 0, 59 cases with Stage 1 to 4. 28 female cases has 7 cases at Stage 0 and 21 cases at Stage 1 to 4. So, 20 cases are at Stage 0 and 80 cases are at Stage 1 to 4 on male and female combined statistics.

Age group 61 to 70 years has 60 cases, of which male are 46 and female are 14. Of 46 male, no case is at Stage 0 and all 46 cases are at Stage 1 to 4. Of 14 female, 1 case is at Stage 0 and other 13 cases are at Stage 1 to 4. 1 case at Stage 0 and other 59 cases at Stage 1 to 4 is the combined value.

Last age group with 71 to 80 years has got 35 cases. Out of this 23 are male and 12 are female. 23 male has only 1 subject at Stage 0 and other 22 subjects at Stage 1 to 4. Among 12 female no case is at Stage 0 and other 12 are at Stage 1 to 4. Combining the values we get 1 cases at Stage 0 and 34 cases at Stage 1 to 4.

To summarize, Sagittal suture Middle one third in 358 male and 142 female skulls examined is found to have Stage 0 in 298 skulls (208 male, 90 female) and Stage 1 in 202 (150 male, 52 female) skulls.

Chart 8: Progression of Stages of fusion with age (SS Middle 1/3)



Progression of fusion status with advancing age

In the Chart 8, orange line indicates male at Stage 0, blue line indicates female at Stage 0, Violet line indicates male at Stage 1 and brown line indicates female at Stage 1. As we move from age group 21 to 30 y towards 51 to 60 y the percentage of Stage 0 decreases in both male and female population. Indicated by orange (Male – Stage 0) and blue (Female – Stage 0) lines in the chart 8. Beyond that age limit, Stage 0 dips to near 0. Similarly, Stage 1 increase is minimal in 31 to 40 y and 41 to 50 y age groups; increases down the 51 to 60 y and further (In this, Male Stage 1 is indicated by violet lines; female Stage 1 by brown lines). Maximal Stage 1 is clustered around 51 to 60 y and 61 to 70 y age groups.

For, Middle third of Sagittal suture, Mean value for Stage 0 is 40.45 and for Stage 1 is 61.06. SD for Stage 0 is 7.268 and for Stage 1 is 10.796. SE comes to .421 for Stage 0 and .760 for stage 1.

Sagittal suture - Posterior one third:

Age group 21 to 30 years has 13 male & 13 female. Cases at Stage 0 are 6 and at Stage 1 are 7 in male. For female, 10 are at Stage 0 and 3 are at Stage 1. Total of 16 skull at Stage 0, 10 skulls at Stage 1 of fusion.

Age group 31 to 40 years that contributes 156 cases out of 500, 119 male and 37 female cases are present. In 119 male, 11 are at Stage 0 and 108 are at Stage 1 to 4. In 37 female, 5 are at Stage 0 and 32 female cases are at Stage 1 to 4. A total of 16 cases at Stage 0 and 140 cases at Stage 1 to 4 is arrived at.

In this age group of 41 to 50 years, a total of 123 cases contain 85 male and 38 female. Of 85 male, 2 are at Stage 0, 83 are at Stage 1 to 4. Of 38 female, no case at Stage 0, all 38 are at Stage 1 to 4. Combining male and female statistics, we get 2 cases at Stage 0, 121 cases at Stage 1 to 4.

With age group 51 to 60 years having 100 cases, 72 are male and 28 are female. 72 male cases has 2 cases at Stage 0, 70 cases with Stage 1 to 4. 28 female cases has no case at Stage 0 and all the 28 cases at Stage 1 to 4. So, 2 cases are at Stage 0 and 98 cases are at Stage 1 to 4 when male and female values added.

Age group 61 to 70 years has 60 cases, of which male are 46 and female are 14. Of 46 male, no case is at Stage 0 and all 46 cases are at Stage 1 to 4. Of 14 female, no case is at Stage 0 and all 14 cases are at Stage 1 to 4. No case at Stage 0 and all 59 cases at Stage 1 to 4 is the combined value.

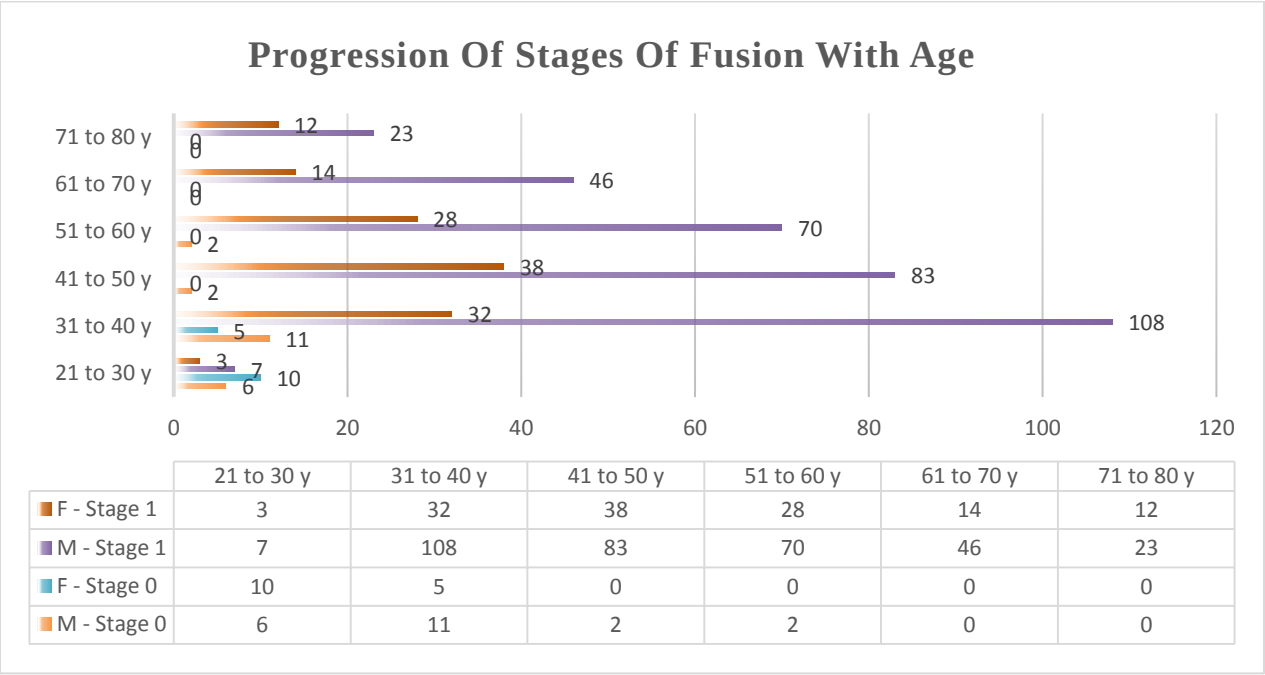
Last age group with 71 to 80 years has got 35 cases. Out of this 23 are male and 12 are female. 23 male has no subject at Stage 0 and all 22 subjects at Stage 1.

Among 12 female no case is at Stage 0 and other 12 are at Stage 1 or above. Combining the values we get no case at Stage 0 and all 35 cases at Stage 1.

To summarize, Sagittal suture posterior one third in 358 male and 142 female skulls examined is found to have Stage 0 in 36 skulls (21 male, 15 female) and Stage 1 in 464 (337 male, 127 female) skulls (Chart 9).

Mean value for Stage 0 is 33.92 and for Stage 1 is 49.93. Standard Deviation for Stage 0 is 6.267, Stage 1 is 13.171. Standard Error is found to be 1.045 for Stage 0 and .611 for Stage 1.

Chart 9: Progression of Stages of fusion with age (SS Posterior 1/3)



	21 to 30 y	31 to 40 y	41 to 50 y	51 to 60 y	61 to 70 y	71 to 80 y
F - Stage 1	3	32	38	28	14	12
M - Stage 1	7	108	83	70	46	23
F - Stage 0	10	5	0	0	0	0
M - Stage 0	6	11	2	2	0	0

Right wing of Lambdoid suture's Upper half:

Age group 21 to 30 years has 13 male at Stage 0, 13 female at Stage 0.

Age group 31 to 40 years has 117 cases of Male at Stage 0, 36 cases of Female at Stage 0; 2 cases of Male at Stage 1 and a case of Female at Stage 1 to 4.

In this age group of 41 to 50 years, 78 cases of Male at Stage 0, 37 cases of Female at Stage 0; 7 cases of Male at Stage 1 and a case of Female Stage 1 to 4.

With age group 51 to 60 years, there are 13 cases of Male at Stage 0, 3 cases of Female at Stage 0; 59 cases of Male at Stage 1 and 25 cases of Female at Stage 1.

Age group 61 to 70 years has a case of Male at stage 0, no case of Female at Stage 0; 45 cases of Male at Stage 1 and 14 cases of Female at Stage 1 to 4.

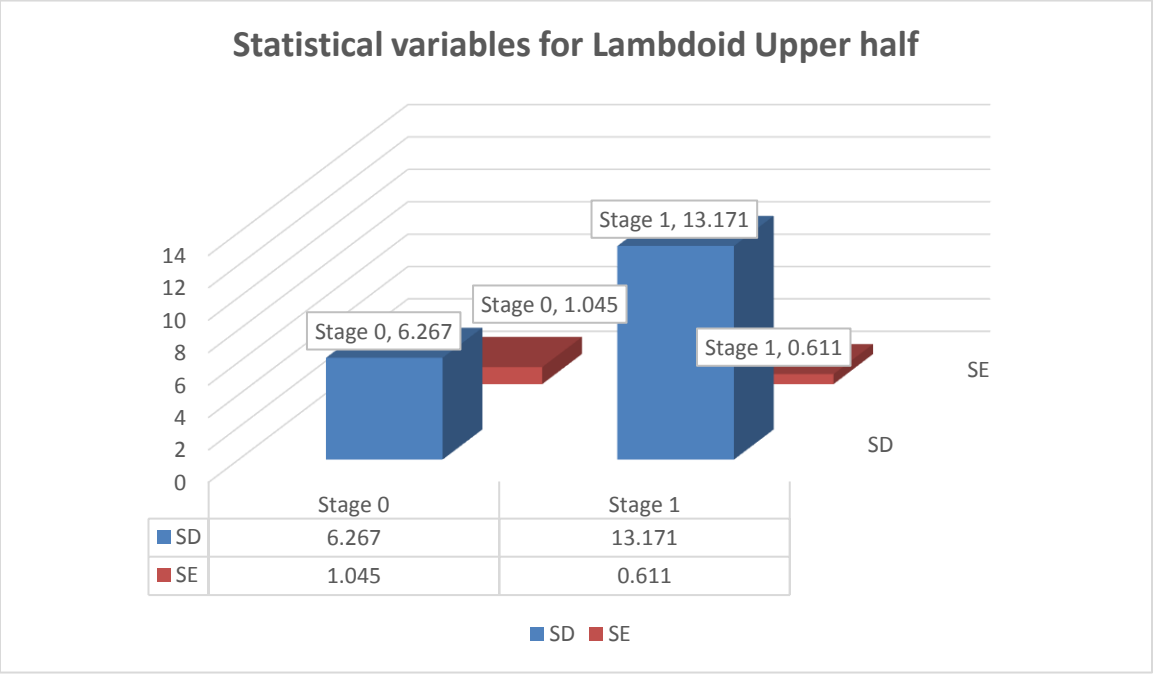
Last age group 71 to 80 years has got a case of Male at Stage 0, no case of Female at Stage 0; 22 cases of Male at Stage 1 and 12 cases of Female at Stage 1 to 4.

Right wing of Lambdoid suture's Upper half has the following findings on statistical analysis:

223 Male skulls at Stage 0, 89 Female skulls at Stage 0;

135 Male skulls at Stage 1 or above and 53 Female skulls at Stage 1 to 4.

Chart 10: Statistical variables for Lambdoid Upper half



SD – Standard deviation (Blue), SE – Standard Error (Red) for Stage 0 & Stage 1.

Following statistical variables are calculated for Right wing of Lambdoid suture's Upper half:

Mean value for Stage 0 is 33.92 and for Stage 1 is 49.93.

Standard Deviation for Stage 0 is 6.267, Stage 1 is 13.171.

Standard Error is found to be 1.045 for Stage 0 and .611 for Stage 1 (Chart 10).

Right wing of Lambdoid suture's Lower half:

Age group 21 to 30 years has 13 male at Stage 0, 13 female at Stage 0.

Age group 31 to 40 years has 118 cases of Male at Stage 0, 36 cases of Female at Stage 0; no case of Male at Stage 1 and a case of Female at Stage 1 to 4.

In this age group of 41 to 50 years, 78 cases of Male at Stage 0, 37 cases of Female at Stage 0; 7 cases of Male at Stage 1 and a case of Female Stage 1 to 4.

With age group 51 to 60 years, there are 81 cases of Male at Stage 0, 38 cases of Female at Stage 0; 4 cases of Male at Stage 1 and no case of Female at Stage 1.

Age group 61 to 70 years has got 3 case of Male at Stage 0, no case of Female at Stage 0; 43 cases of Male at Stage 1 and 14 cases of Female at Stage 1 to 4.

Age group 71 to 80 years has 1 cases of Male at stage 0, no case of Female at Stage 0; 22 cases of Male at Stage 1 and 12 cases of Female at Stage 1 to 4.

Right wing of Lambda suture's Lower half has the following findings on statistical analysis:

272 Male skulls at Stage 0, 109 Female skulls at Stage 0 (Table 8);

85 Male skulls at Stage 1 or above and 33 Female skulls at Stage 1 to 4.

Table 8: Right wing of Lambdoid Lower half

Stage	Male	Female	Total
Stage 0	**272**	**109**	**357**
Stage 1	**85**	**33**	**142**
Total	**381**	**118**	**500**

Following are the statistical variables for Right wing of Lambdoid Lower half:

Mean value for Stage 0 is 43.12 and for Stage 1 is 67.14

Standard deviation for Stage 0 is 8.879 and for Stage 1 is 8.355

Standard error for Stage 0 is .455 and for Stage 1 is .769

Left wing of Lambdoid suture's Upper half:

Statistical similarity between Right wing of Coronal Suture's Upper half & Left wing of Coronal Suture's Upper half; between Right wing of Coronal Suture's Lower half & Left wing of Coronal Suture's Lower half is comparable with the similarity between Right wing of Lambdoid suture Upper half and Left wing of Lambdoid suture Lower half.

Asymmetry:

The following cases exhibit asymmetry in fusion status between Right and Left wings of Lambda suture's Upper half:

96. 426/13 50/M	R 2 0	L 1 0
143. 612/13 74/M	R 2 3	L 3 3

Since the asymmetry is not between Stage 0 and Stage 1 but within Stage 1 (i.e. between Stage 1 and Stage 2; between Stage 2 and Stage 3) no statistical analysis variation is observed between Right and Left wings. Hence, statistical distribution and results are same for Right wing of Lambda suture's Upper half and Left wing of Lambda suture's Upper half.

Left wing of Lambdoid suture's Lower half:

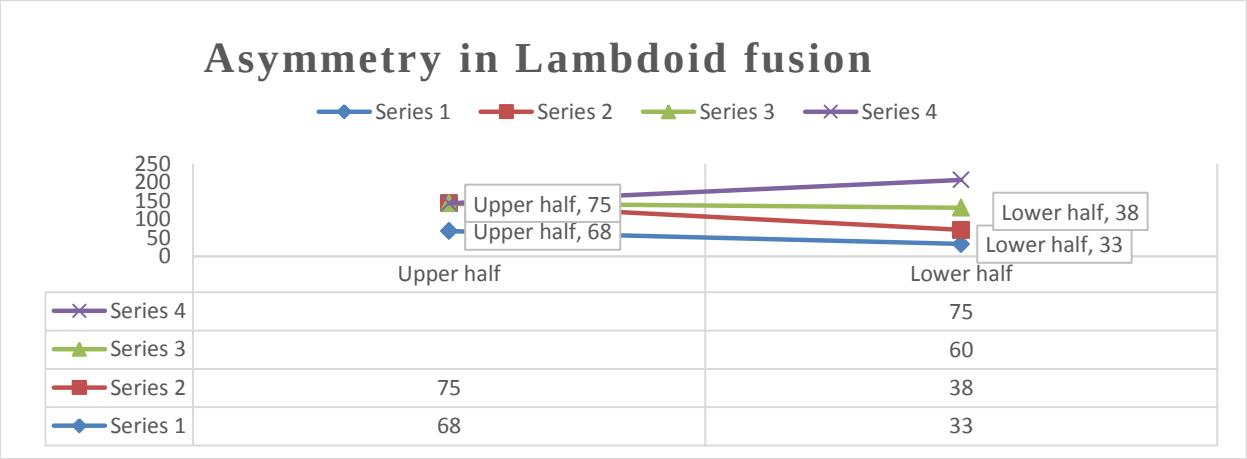
Asymmetry between Right and Left wings of Lambdoid suture's Lower half is dealt first to arrive at the statistical variables for this part of suture. The following four cases are having asymmetry in fusion status in relation to right and left wings:

Asymmetry:

242. 1040/13 33/M	R 0 2	L 0 1
285. 1499/13 38/F	R 0 3	L 0 1
305. 27/14 60/F	R 2 1	L 2 2
345. 456/14 75/M	R 3 3	L 3 2

Asymmetry is between Stage 1 & Stage 2, Stage 1 & Stage 3, Stage 1 & Stage 2 and Stage 3 & Stage 2 (i.e. within Stage 1 of statistics). Since this asymmetry is similar to the asymmetry in Lambdoid suture's upper half, no statistical differences are created by this. Hence, the variables of statistics for Left wing of Lambda suture's Lower half is same as that of Right wing of Lambdoid Suture's lower half.

Chart 11: Asymmetry in Lambdoid suture fusion



Right Squamous Temporal suture:

Age group 21 to 30 years has 13 male at Stage 0, 13 female at Stage 0.

Age group 31 to 40 years has 119 cases of Male at Stage 0, 37 cases of Female at Stage 0; no case at Stage 1.

In this age group of 41 to 50 years, 84 cases of Male at Stage 0, 38 cases of Female at Stage 0; 1 case of Male at Stage 1 and no case of Female Stage 1 to 4.

With age group 51 to 60 years, there are 69 cases of Male at Stage 0, 26 cases of Female at Stage 0; 3 cases of Male at Stage 1 and 2 cases of Female at Stage 1.

Age group 61 to 70 years has got 39 cases of Male at Stage 0, 11 cases of Female at Stage 0; 7 cases of Male at Stage 1 and 3 case of Female at Stage 1 to 4.

Age group 71 to 80 years has 12 cases of Male at stage 0, 4 cases of Female at Stage 0; 11 cases of Male at Stage 1 and 8 cases of Female at Stage 1 to 4.

Right squamous temporal suture has the following findings on statistical analysis:

336 Male skulls at Stage 0, 129 Female skulls at Stage 0;

22 Male skulls at Stage 1 or above and 13 Female skulls at Stage 1 to 4.

Left Squamous Temporal suture:

Since no asymmetry is observed between the Right and Left temporal suture,

Following are the statistical variables for Squamous Temporal suture.

Mean for Stage 0 is 47.06, Stage 1 is 71.51.

SD for Stage 0 is 12.128, for Stage 1 is 8.658.

SE for Stage 0 is .562 and for Stage 1 is 1.463.

DISCUSSION

DISCUSSION:

Skull morphology:

Skull, a Pandora's Box for Forensic persons has an unusual anatomy when compared to other bones in our body. This unusual anatomy is due to appositional bone growth by two periosteal layers, where resorption is exceeded by apposition at certain sites. But in long bones, there exists a constant relationship between the periosteal apposition and endosteal resorption.

Cranial Sutures:

A suture is junction of two or more bones, where they meet in spikes or interlocking pattern of bone growth. It is formed by a layer of osteogenic cells (Cambial layer) overlaid by a lamella of fibrous tissue. These two layers together correspond to periosteal layer and are continuous with the latter at margins of sutural surface, both inside and outside of skull. Between these two periosteal layers is a central stratum of loosely arranged fibrous tissue. In other words, a suture is an ossified part of a dermal bone that develops from mesenchyme.

Cranial sutures begin as simple and straight sutures, but they become more complex, through growth and bone resorption developing inter digitations as time progresses. Cranial sutures are similar to epiphysis diaphysis junction.

Both are loci of bone growth and have a time sequence in their union. Cranial sutures begin to close from internal side, Tabula interna or Inner table. This union spreads from inwards to outwards, endocranial to ectocranial. Hence, endocranial suture closure is earlier than its ectocranial counterpart. Cranial sutures close in specific age sequence like any other growth plate union; this is useful in estimating age at death of a deceased. This study is about using ectocranial sutures as a tool for age estimation in a sample of 500 bodies during autopsy at our center. Cranial Sutures visible on various skull views are as follows:

Norma Verticalis:

Sagittal (between the Parietals),

Coronal (between Frontal and Parietals) and

Lambdoid Sutures (between Parietals and Occipital bones).

Norma Occipitalis:

Lambdoid,

Parieto Mastoid and

Occipito Mastoid sutures.

Norma Frontalis:

Fronto Nasal,

Fronto Zygomatic,

Inter Nasal,

Fronto Maxillary and

Zygomatico Maxillary sutures.

Norma Lateralis:

H shaped suture.

Forensic Uses: From sutures, the following identification points

Origin (well-defined Ectocranial and Endocranial sutures in humans),

Ancestry and Sex to some extent (sutural bones are more common in Asian descent, sutural bones and metopic suture is common in female),

Age (by suture closure pattern),

Identity – as a point of individualistic phenomena even in identical twins can be found [(10)] and

Stature [(11)] can be found.

Suture closure or obliteration:

Of many sutures in the skull, only four of vault sutures [12] are taken for this study. Those include Sagittal, Coronal, Lambdoid and Temporal (squamous part) sutures in a sample of 500 skulls of deceased local population. Hence, migratory population working at the industries in and around our region is excluded from this study. Idea of excluding migratory population is further supplemented by some works claiming short life expectancy people have restricted bony development [13]. Since, the life expectancy varies with various populations, single population or local population is studied.

Studies on cranial sutures are conducted by Indian scholars Patil T.L (1981), Bhagwat S.S (1983) and Chandrashekharan P. (1985), Dr.Bimal Chandra (1984, Delhi), Vyas P C (1996), Moondra A.K (2000), Rajesh kumar verma(2002), Dr.Pradeep singh (2004,Patiala) [14] .

Factors affected:

Suture closure is affected by many factors such as Genetic differences [15], race [16] or ancestry [4], [18] and nutrition on skeletal maturity [19], climate [16], stress and sex. It is observed that simple sutures are closed early than serrated ones [17].

Studies claim that there is no group difference in respect to skull thickness [20] and hence no variation among population [21] in suture fusion. Sutures may be genetic [9] inherited, Atavistic [15]. Autosomal Dominant or Autosomal Recessive pattern of inheritance as a cause of PMSC – Pre Mature Suture Closure [22] are also studied. Few studies strictly oppose this view of inheritance of cranial sutures [10].

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But Genetic differences, climatic differences and race are not different in local population. Regarding nutrition, moderately nourished bodies or bodies with no autopsy signs of malnutrition are selected. To maximum extent possible, people with bony defects (congenital or developmental) are also excluded from this study.

Sex and cranial suture fusion has two views, one is No sex differences in skull suture [14] [16] [23] [24] [25] [26] [27] [28] [29]. Other view is sex difference influences suture closure. If sex difference [18] [30] is there, closure in male is earlier [31] [32] or Females have later closure pattern of sutures [4] [17] [33] [34]. In this study no such sex difference is observed. This result is in line with these studies and references [14] [16] [23] [24] [25] [26] [27] [28] [29].

Age of non-fusion & fusion:

Coronal suture Upper half:

Mean age of non-fusion of Coronal suture Upper half (on Right and Left wing) is 40.12 years with SD – 7.467, SE - .448, p = 0.00 (Statistically significant with age)

This result is in line with Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40], Bardale [28], Chandha [41], Brash [42], and Glaister [43].

Contradiction with Glaister John [44], Singhal [45].

Mean age of fusion of Coronal suture Upper half (on Right and Left wing) is 59.62 years with SD – 11.233, SE - .754, p = 0.00 (Statistically significant with age)

This result is in line with Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40], Chandha [41].

In conflict with Glaister John [44], Bardale [28], Singhal [45].

Coronal suture Lower half:

Mean age of non-fusion of Coronal suture Lower half (on Right and Left wing) is 38.61 years with

SD – 8.205, SE - .568, p = 0.00.

This is in line with Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40], Bardale [28] and Brash [42]

Contradicted by Singhal [45] Chandha [41]

Mean age of fusion of Coronal suture Lower half (on Right and Left wing) is 56.08 years with

SD – 11.620, SE - .681, p = 0.00.

This result is supported by Chandha [41],

Contradicted by Guharaj & Chandran [35], Brash [42], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40], Bardale [28], Glaister John [44].

Sagittal suture Anterior one third:

Mean age of non-fusion of Sagittal Anterior one third 37.34 years with

SD – 6.530, SE - .475, p = 0.00.

This is in line with Bardale [28], Singhal [45], Brash [42] and

Contradicted by Glaister John [44], Chandha [41], Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40].

Mean age of fusion of Sagittal Anterior one third 55.72 years with

SD – 11.713, SE - .664, p = 0.00.

This result is supported by Chandha [41],

Contradicted by Guharaj & Chandran [35], Brash [42], Krishnan [36], Mestri [37], Bardale [28], Rao NG [38], Nagesh Kumar [39], Singhal [45], Umadethan [40] and Glaister John [44]

Sagittal suture Middle one third:

Mean age of non-fusion of Sagittal Middle one third 40.45 years

with SD – 7.268, SE - .421, p = 0.00.

This result is in line Bardale [28] Brash [42] Singhal [45].

Contradicted by Chandha [41], Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40], Glaister John [44] [45]

Mean age of fusion of Sagittal Middle one third 61.06 years

with SD – 10.796, SE - .760, p = 0.00.

This result is supported by Chandha [41],

Contradicted by Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Singhal [45], Umadethan [40], Glaister John [44] [45].

Sagittal suture Posterior one third:

Mean age of non-fusion of Sagittal Posterior one third 33.92 years

with SD – 6.267, SE - 1.045, p = 0.00.

This is in connection with Bardale [28], Singhal [45], and Glaister John [44] [45].

Contradicted by Guharaj & Chandran [35], Krishnan [36], Mestri [37], Nagesh Kumar [39], Rao NG [38], Umadethan [40], Chandha [41]

Mean age of fusion of Sagittal Posterior one third 49.93 years

with SD – 13.171, SE - .611, p = 0.00.

This this result is contradicted by Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40] and

Partly supported by Chandha [41].

Lambdoid suture Upper half:

Mean age of non-fusion of Lambdoid suture Upper half (on Right and Left wing) is 40.36 years with

SD – 7.102, SE - .402, p = 0.00.

This result is supported by Singhal [45], Bardale [28], Glaister John [44] and

Contradicted by Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40].

Mean age of fusion of Lambdoid suture Upper half (on Right and Left wing) is 62.75 years with

SD – 9.174, SE - .669, p = 0.00.

This result is contradicted by Brash [42], K1 M1 R 1 R 2 U 1 and

Supported by Chandha [41].

Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40].

Lambdoid suture Lower half:

Mean age of non-fusion of Lambdoid suture Lower half (on Right and Left wing) is 43.12 years

with SD – 8.879, SE - .455, p = 0.00.

This result is supported by Glaister John [44] [45], Singhal [45], Bardale [28] and

Contradicted by Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Umadethan [40].

Mean age of fusion of Lambdoid suture Lower half (on Right and Left wing) is 67.14 years with

SD – 8.355, SE - .769, p = 0.00.

This result is contradicted by Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39] and Umadethan [40].

Supported by Chandha [41].

Temporal (squamous) suture:

Mean age of non-fusion of Squamous temporal suture is 47.06 years with SD – 12.128, SE - .562, p = 0.00.

This result is contradicted by Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39] and Umadethan [40].

Mean age of fusion of Squamous temporal suture is 71.51 years with SD – 8.658, SE - 1.463, p = 0.00.

This study is supported by Guharaj & Chandran [35], Krishnan [36], Mestri [37], Rao NG [38], Nagesh Kumar [39], Singhal [45], Umadethan [40], Glaister John [44] [45] .

After analysis, Sagittal suture starts closing at posterior one third corresponding to Obelion [29]. If not closed, age can be less than thirty years [29]. Open suture at posterior one third is not common [42]. In Coronal suture, fusion starts at lower half of suture and the reverse in Lambdoid suture. This result is supported by Das & Ranjan [46]. But the sequence is different in that study (C, S, L compared to this study S C L for fusion sequence).

Hence, when we find biological age, as age progresses there is dissociation of chronological and biological age [47] due to this influences mentioned above.

Reliability:

Reliability of skull sutural closure pattern has many variables to consider. They are asymmetry, wide range, premature closures, and lapsed unions.

Asymmetry in suture closure can occur on either side with no bias for one side over the other [48] [30] and there are also mention of age of asymmetry incidence between 36 to 40 y and 61 to 65 [48], and 41 to 50 years [49].

Works on this field claim no differences between right and left side closure also [14] [17] [21] [28].

Second issue of reliability is that the estimated age at death of an individual can be given only in a range of one or two decades using the sutural pattern of closure. Hence, its reliability in age estimation is considered not accurate [15] [25] [29] [32] [34] and [50]. This technique can be used with caution or prudence [51], or by combining sutures [12]. It is considered unreliable mainly because of this reason as a narrow span of 2 to 3 years age limit is not possible using this technique. Other authors claim this to be erratic, too variable [31] [52] [53] [54], not relating to age, under estimates age [55]

Lapsed union in an ecto cranial suture is often a recognizable feature. Bone on either side of the outer suture is piled up indicating the lapsed union of ecto cranial suture [56]. Since, endo cranium is not included in this study, this entity is left out.

Another problem mentioned in texts about cranial suture pattern is closure at early age. If the skull sutures close before the age of 7 years, it is termed as precocious closure. If the skull sutural closure is advanced than its expected age limit but after the age of 7 years, it is termed as pre mature closure [15] [57] [58]. Inclusion criteria of this study rules out this possibility.

There are instances of 12 – 14 y having Complete Fusion status [58].

Additions:

Following are some interesting findings that are encountered while conducting this study on 500 skulls.

Metopism (a condition due to persistence of metopic suture in 3 skulls),

Sutural bones - SB (are encountered in 4 cases)

262 & 355. Coronal SB (Os Epiteric), 9, 368. Occipital SB (Os Kerckring),

Inca bone variable (is encountered in a skull),

Size of parietal foramen is so large like a burr hole (Anatomical variation)

Receding coronal suture (Bregma is pushed posteriorly)

Double Y suture [9], Sagittal is completely fused but not Coronal, Lambdoid (18, 203, 294, 341, and 355 – five cases).

Healed depressed fracture (438).

Color of skull (yellow in jaundice, brown in unknown poison, red in decomposition, pearly white in burns).

CONCLUSION

CONCLUSION:

This study on age estimation from cranial suture closure to prove or disprove ages of sutural closure in routine practice has following conclusions:

Cranial suture fusion is not influenced by sex or there is no sex difference.

Side difference is present in suture fusion.

Side difference in fusion does not alter mean ages of fusion or non-fusion.

Mean age of fusion of Coronal suture Upper half is 59.62 years.

Mean age of fusion of Coronal suture Lower half is 56.08 years.

Mean age of fusion of Sagittal suture Anterior one third is 55.72 years.

Mean age of fusion of Sagittal suture Middle one third is 61.06 years.

Mean age of fusion of Sagittal suture Posterior one third is 49.93 years.

Mean age of fusion of Lambda suture Upper half is 62.75 years.

Mean age of fusion of Lambda suture Lower half is 67.14 years

Mean age of fusion of Temporal (squamous) suture is 71.51 years

Sagittal suture is more reliable followed by Coronal suture.

Metopism is found in 0.006 % of skulls between 30 to 80 years.

Sutural bones are found in 0.008 % of skulls between 30 to 80 years.

Inca variable in 0.002% of skulls between 30 to 80 years.

Double Y suture is found in 0.01 % of skulls between 30 to 80 years.

Cranial suture closure as such as an age estimation tool is not reliable and highly variable. However, broad age limit in a span of decades can be said.

RECOMMENDATIONS

RECOMMENDATIONS:

Studies be conducted with more female cases in sample. Equal distribution of sex in total samples can be tried.

Sample size can be taken still large to cover most of population and to obtain more statistical significance.

Cranial suture closure age is different in different population. This age of fusion can be considered for this local population.

Suture closure technique for both outer and inner sides of skull be assessed and compared.

Regression formula for individual sutures [59] can be tried.

Posterior one third of Sagittal suture and Lower half of Coronal suture can be studied with larger sample size.

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ANNEXURE – III: Colour Plates

Age group: 30 to 40 years

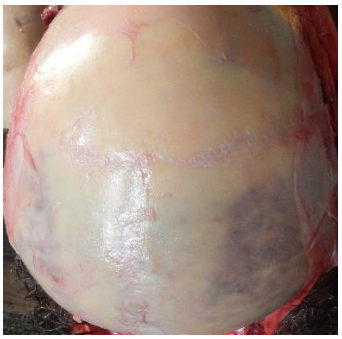
S 0 0 0, L 0 0 – Suture bone in Lambdaoid suture

S 0 0 1, C 0 0

S 0 0 0, C 0 0 - Metopism

Age group: 41 to 50 years

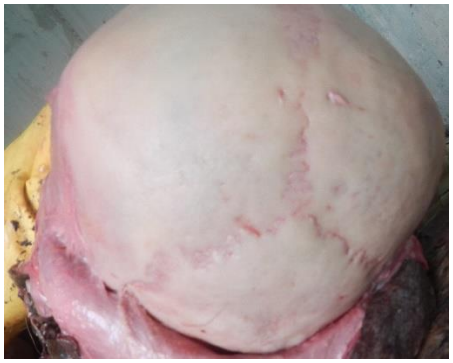
S 1 0 1; C R 0 0, C L 0 0



S 1 0 1; C R 0 1, C L 0 1

L R 3 3; L L 3 3

Age group: 51 to 60 years



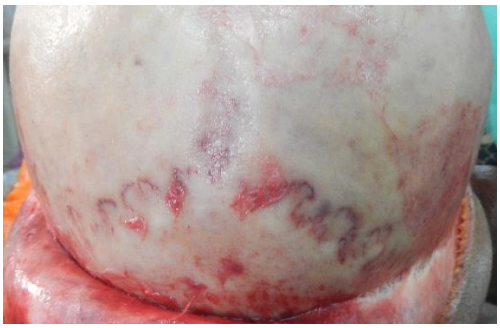
L R 1 0; L L 1 0

L R 3 1; L L 3 1

S 2 1 2

Age group: 61 to 70 years

S 3 3 4 with Metopism



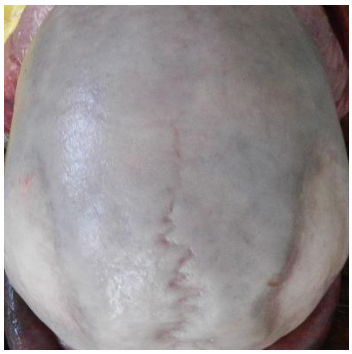
L R 1 1; L L 1 1

L R 2 2; L L 2 2

Age group: 71 to 80 years

Sagittal completely fused

T R 1



S 2 2 3, C R 2 2, C L 2 2

ANNEXURE – IV: Master chart

Serial no.	PM no.	Station & Crime no.	Age	Coronal suture	Sagittal suture	Lambdoid suture	Temporal suture
1.	1569/12	Surandai 141/12	60/F	R 3 3 L 3 3	3 3 4	R 3 3 L 3 3	R 1 L 1
2.	144/13	Thisayanvilai 25/13	40/M	R 0 1 L 0 1	2 0 4	R 0 0 L 0 0	R 0 L 0
3.	149/13	Thatchanallur 50/13	42/F	R 0 1 L 0 1	0 0 1	R 0 0 L 0 0	R 0 L 0
4.	153/13	Nanguneri 27/13	65/F	R 1 0 L 1 0	2 1 2	R 1 1 L 1 1	R 1 L 1
5.	155/13	TvMCH 42/13	70/M	R 2 2 L 2 2	3 3 3	R 2 1 L 2 1	R 1 L 1
6.	160/13	Nanguneri 29/13	45/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
7.	172/13	Cheranmahadevi 38/13	75/M	R 2 2 L 2 2	2 2 3	R 3 3 L 3 3	R 4 L 4
8.	173/13	Meignanapuram 44/13	57/M	R 2 2 L 2 2	2 1 3	R 2 2 L 2 2	R 0 L 0
9.	186/13 (SB)	Karivalamvantha Nallur 26/13	34/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
10.	192/13	Thatchanallur 36/13	35/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
11.	249/13	Puliyangudi 69/13	51/F	R 0 1 L 0 1	2 0 3	R 0 0 L 0 0	R 0 L 0
12.	251/13	Alangulam 85/13	40/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
13.	252/13	Manur 59/13	45/F	R 0 0 L 0 0	1 0 3	R 0 0 L 0 0	R 0 L 0

14.	254/13	Perumalpuram 109/13 (convict)	45/M	R 3 3 L 3 3	3 3 4	R 3 3 L 3 3	R 0 L 0
15.	255/13	Thisayanvilai 48/13	32/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
16.	259/13	TvMCH 67/13	40/M	R 0 1 L 0 1	0 0 2	R 0 0 L 0 0	R 0 L 0
17.	261/13	Gangaikondan 35/13	40/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
18.	267/13	Thirukurangudi 17/13	80/F	R 3 2 L 3 2	4 4 4	R 3 3 L 3 3	R 2 L 2
19.	268/13	Murappanadu 43/13	35/F	R 0 0 L 0 0	0 0 3	R 0 0 L 0 0	R 0 L 0
20.	269/13	Alwarthirunagari 36/13	37/M	R 1 1 L 1 1	1 0 3	R 0 0 L 0 0	R 0 L 0
21.	270/13	Sethur 99/13	55/F	R 1 1 L 1 1	2 1 4	R 1 0 L 1 0	R 0 L 0
22.	276/13	Perumalpuram 117/13 (Convict)	31/M	R 1 1 L 1 1	2 1 4	R 0 0 L 0 0	R 0 L 0
23.	278/13	TIN Taluk 80/13	40/M	R 0 2 L 0 2	3 0 2	R 0 0 L 0 0	R 0 L 0
24.	279/13	Thalaiyuthu 44/13	35/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
25.	282/13	Perumalpuram 126/13 Convict (HIV)	40/M	R 0 0 L 0 0	1 0 3	R 0 0 L 0 0	R 0 L 0
26.	284/13	TIN Town 245/13	63/M	R 3 3 L 3 3	3 2 4	R 3 2 L 3 2	R 0 L 0
27.	288/13	TIN railway 76/13	64/M	R 1 1 L 1 1	1 1 3	R 1 1 L 1 1	R 1 L 1
28.	289/13	Alwarthirunagari	45/M	R 0 2	1 0 3	R 0 0	R 0

		44/13		L 0 2		L 0 0	L 0
29.	292/13	Kayathar 58/13	43/M	R 0 1 L 0 1	1 0 3	R 0 0 L 0 0	R 0 L 0
30.	293/13	Thalaiyuthu 45/13	35/M	R 0 0 L 0 0	0 0 3	R 0 0 L 0 0	R 0 L 0
31.	294/13	Manur 65/13	38/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
32.	295/13	Vasudevanallur 62/13	50/M	R 2 2 L 2 2	3 0 3	R 2 0 L 2 0	R 0 L 0
33.	296/13	Thisayanvilai 60/13	38/M	R 0 1 L 0 1	0 0 2	R 0 0 L 0 0	R 0 L 0
34.	297/13	Moolakaraipatti 15/13	60/M	R 2 2 L 2 2	3 2 4	R 2 0 L 2 0	R 0 L 0
35.	301/13	Alwarkurichi 73/13	45/M	R 0 1 L 0 1	2 0 3	R 0 0 L 0 0	R 0 L 0
36.	302/13	Murappanadu 48/13	45/M	R 0 0 L 0 0	2 0 3	R 0 0 L 0 0	R 0 L 0
37.	305/13	Kalakkad 68/13	55/M	R 2 3 L 2 3	3 3 4	R 3 1 L 3 1	R 0 L 0
38.	307/13	Perumalpuram 138/13	40/F	R 0 1 L 0 1	1 1 3	R 0 0 L 0 0	R 0 L 0
39.	310/13	Muneerpallam 92/13	40/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
40.	311/13	Alangulam 111/13	70/F	R 2 2 L 2 2	2 2 3	R 2 2 L 2 2	R 0 L 0
41.	312/13	TIN Taluk 83/13	72/M	R 3 3 L 3 3	3 3 4	R 2 2 L 2 2	R 0 L 0
42.	313 /13	Alangulam 113/13	40/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0

43.	314/13 73/13	Ambasamudram	38/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
44.	315/13 89/13	Puliyangudi	34/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
45.	316/13 27/13	Seidunganallur	55/M	R 1 2 L 1 2	2 2 4	R 2 0 L 2 0	R 0 L 0
46.	317/13 49/13	Uthumalai	55/M	R 1 2 L 1 2	2 1 4	R 2 0 L 2 0	R 0 L 0
47.	318/13 Pannai 76/13	Ezhayiram	65/M	R 2 2 L 2 2	3 2 4	R 2 2 L 2 2	R 0 L 0
48.	319/13 29/13	Pappagudi	72/M	R 2 3 L 2 3	3 3 4	R 3 2 L 3 2	R 0 L 0
49.	320/13 328/13	TIN junction	35/M	R 0 0 L 0 0	1 0 2	R 0 0 L 0 0	R 0 L 0
50.	321/13 201/13	Pettai	31/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
51.	322/13 19/13	Moolakaraipatti	37/F	R 0 0 L 0 0	0 0 3	R 0 0 L 0 0	R 0 L 0
52.	324/13 341/13	TIN junction	33/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
53.	326/13 279/13	TIN town	49/M	R 0 1 L 0 1	2 0 3	R 0 0 L 0 0	R 0 L 0
54.	327/13 219/13	Palayankottai	55/M	R 2 3 L 2 3	3 4 4	R 2 0 L 2 0	R 0 L 0
55.	329/13 66/13	Arumuganeri	68/M	R 3 3 L 3 3	3 3 4	R 3 3 L 3 3	R 0 L 0
56.	330/13 78/13	Sernthamaram	33/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
57.	331/13 37/13	Moondradaippu	55/M	R 2 2 L 2 2	2 2 4	R 2 0 L 2 0	R 0 L 0

58.	334/13	Pavoorchathiram 89/13	51/M	R 0 1 L 0 1	2 1 3	R 0 0 L 0 0	R 0 L 0
59.	336/13	Sathur 156/13	47/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
60.	337/13	Kadayanallur 85/13	60/M	R 2 3 L 2 3	2 2 4	R 2 0 L 2 0	R 0 L 0
61.	338/13	Seidunganallur 29/13	36/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
62.	339/13	Thalaiyuthu 47/13	55/M	R 1 2 L 1 2	2 1 3	R 1 0 L 1 0	R 0 L 0
63.	340/13	Palaiyankottai 226/13	79/M	R 1 1 L 1 1	1 1 2	R 4 3 L 4 3	R 1 L 1
64.	342/13	Alangulam 120/13	45/M	R 0 1 L 0 1	1 0 3	R 0 0 L 0 0	R 0 L 0
65.	344/13	Cheranmahadevi 80/13	76/M	R 3 3 L 3 3	3 3 4	R 4 3 L 4 3	R 0 L 0
66.	347/13	TIN Taluk 87/13	58/F	R 1 1 L 1 1	0 0 3	R 2 0 L 2 0	R 0 L 0
67.	348/13	Pappagudi 31/13	32/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
68.	349/13	Pettai 221/13	58/M	R 2 2 L 2 2	1 1 4	R 2 0 L 2 0	R 0 L 0
69.	350/13	Kadayam 71/13	48/M	R 1 1 L 1 1	1 0 2	R 0 0 L 0 0	R 0 L 0
70.	351/13	Kadayanallur 99/13	50/M	R 1 2 L 1 2	2 0 4	R 0 0 L 0 0	R 0 L 0
71.	352/13	Pettai 234/13	57/M	R 2 2 R 2 2	2 2 4	R 2 0 L 2 0	R 0 L 0
72.	354/13	Gangaikondan	67/M	R 3 2	2 3 4	R 2 2	R 0

		47/13		L 3 2		L 2 0	L 0
73.	356/13	Tenkasi 171/13	39/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
74.	357/13	TIN TIW 83/13	52/F	R 1 2 L 1 2	2 0 3	R 1 0 L 1 0	R 0 L 0
75.	361/13	Moolakaraipatti 25/13	65/F	R 3 2 L 3 2	2 3 4	R 2 1 L 2 1	R 0 L 0
76.	362/13	Karungal Palayam 170/13	35/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
77.	363/13	Veeravanalloor 85/13	65/M	R 3 2 L 3 2	2 2 4	R 3 2 L 3 2	R 0 L 0
78.	365/13	Thatchanallur 170/13	33/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
79.	371/13	TIN junction 392/13	45/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
80.	380/13	Eppothum- Vendran 20/13	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
81.	382/13	Palaiyankottai 257/13	56/F	R 1 1 L 1 1	1 1 3	R 1 0 L 1 0	R 0 L 0
82.	385/13	Vasudevanallur 74/13	60/M	R 2 2 L 2 2	2 1 3	R 1 0 L 1 0	R 0 L 0
83.	386/13	Surandai 74/13	34/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
84.	388/13	Thirukurangudi 25/13	40/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
85.	390/13	Kadayam 91/13	42/M	R 0 1 L 0 1	0 0 3	R 0 0 L 0 0	R 0 L 0
86.	402/13	TIN Taluk 97/13	30/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0

87.	403/13 125/13	Muneerpallam	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
88.	407/13 96/13	TIN Taluk	57/M	R 2 2 L 2 2	2 2 4	R 2 0 L 2 0	R 0 L 0
89.	408/13 71/13	Thisayanvilai	30/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
90.	409/13 225/13	Melapalayam	44/F	R 0 1 L 0 1	1 0 3	R 0 0 L 0 0	R 0 L 0
91.	410/13 82/13	Kayathar	50/M	R 1 2 L 1 2	2 0 3	R 0 0 L 0 0	R 0 L 0
92.	413/13 83/13	Kayathar	40/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
93.	416/13 56/13	Karivalam Vanthanallur	56/M	R 1 1 L 1 1	1 1 3	R 2 0 L 2 0	R 0 L 0
94.	424/13 112/13	Kallidaikurichi	80/M	R 2 3 L 2 3	2 2 4	R 2 2 L 2 2	R 0 L 0
95.	425/13 112/13	Kallidaikurichi	50/F	R 2 1 L 2 1	1 2 3	R 0 0 L 0 0	R 0 L 0
96.	426/13 33/13	Thirukurangudi	50/M	R 1 1 L 1 1	1 1 3	R 2 0 L 1 0	R 0 L 0
97.	428/13 Chathiram 36/13	Panavadali	41/F	R 0 2 L 0 2	0 0 2	R 0 0 L 0 0	R 0 L 0
98.	429/13 103/13	Alwarkurichi	55/M	R 2 1 L 2 1	2 1 3	R 2 0 L 2 0	R 0 L 0
99.	431/13 97/13	Cheranmahadevi	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
100.	439/13 34/13	Thirukurangudi	47/F	R 0 2 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
101.	448/13 365/13	TIN town	47/M	R 0 2 L 0 2	2 0 3	R 0 0 L 0 0	R 0 L 0

102.	455/13	Thisayanvilai 75/13	52/M	R 2 3 L 2 3	2 2 3	R 1 0 L 1 0	R 0 L 0
103.	464/13	Melapalayam 261/13	33/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
104.	472/13	Murappanadu 73/13	47/M	R 0 2 L 0 2	2 0 2	R 0 0 L 0 0	R 0 L 0
105.	474/13	Moolakaraipatti 40/13	60/M	R 2 3 L 2 3	2 2 4	R 1 1 L 1 1	R 0 L 0
106.	475/13	Moolakaraipatti 40/13	46/M	R 0 0 L 0 0	1 0 1	R 0 0 L 0 0	R 0 L 0
107.	476/13	Moolakaraipatti 40/13	45/F	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
108.	480/13	Sivanthipatti 20/13	45/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
109.	486/13	Chokkampatti 54/13	30/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
110.	490/13	Kalakkad 111/13	37/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
111.	493/13	TIN junction 436/13 (premature grey)	35/M	R 1 2 L 1 2	1 2 4	R 0 0 L 0 0	R 0 L 0
112.	494/13	Muneerpallam 170/13	45/F	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
113.	495/13	Alangulam 187/13	45/M	R 0 1 L 0 1	2 0 3	R 0 0 L 0 0	R 0 L 0
114.	499/13	Erode town 250/13	36/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
115.	500/13	Panavadali Chathiram 46/13	61/M	R 2 2 L 2 2	1 2 3	R 1 1 L 1 1	R 0 L 0
116.	502/13	Seidunganallur	32/M	R 0 0	0 0 1	R 0 0	R 0

		40/13		L 0 0		L 0 0	L 0
117.	505/13	Kuruvikulam 59/13	35/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
118.	507/13	Pettai 315/13	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
119.	510/13	Pettai 325/13	35/M	R 0 0 L 0 0	0 0 3	R 0 0 L 0 0	R 0 L 0
120.	512/13	Thattarmadam 87/13	55/M	R 2 2 L 2 2	2 1 4	R 1 0 L 1 0	R 0 L 0
121.	513/13	Kalakkad 122/13	35/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
122.	525/13	Melapalayam 275/13	31/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
123.	526/13	Alangulam 200/13	30/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
124.	564/13	Manur 137/13	45/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
125.	567/13	Thalaiyuthu 97/13	43/M	R 0 0 L 0 0	1 0 2	R 0 0 L 0 0	R 0 L 0
126.	573/13	Perumalpuram 237/13	60/M	R 2 1 L 2 1	2 2 4	R 2 1 L 2 1	R 0 L 0
127.	574/13	Suthamali 121/13	55/F	R 1 1 L 1 1	1 1 3	R 1 0 L 1 0	R 0 L 0
128.	576/13	TIN taluk 125/13	40/M	R 0 0 L 0 0	1 0 2	R 0 0 L 0 0	R 0 L 0
129.	578/13	Moondradaipu 63/13	35/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
130.	580/13	Naalaatinputhur 58/13	58/M	R 1 2 L 1 2	2 1 4	R 2 0 L 2 0	R 0 L 0

131.	582/13 102/13	Thalaiyuthu	32/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
132.	583/13 103/13	Thalaiyuthu	40/F	R 0 1 L 0 1	0 0 2	R 0 0 L 0 0	R 0 L 0
133.	584/13 61/13	Uvari	33/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
134.	585/13 108/13	Thisayanvilai	51/M	R 1 2 L 1 2	1 0 3	R 0 0 L 0 0	R 0 L 0
135.	586/13 120/13	Cheranmahadevi	30/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
136.	591/13 370/13	Palaiyankottai	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
137.	596/13 190/13	Valliyoor	52/M	R 1 2 L 1 2	2 1 4	R 1 0 L 1 0	R 0 L 0
138.	597/13 192/13	Valliyoor	47/F	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
139.	598/13 388/13	Palaiyankottai	53/M	R 1 1 L 1 1	1 1 2	R 1 0 L 1 0	R 0 L 0
140.	605/13 158/13	Pavoorchathiram	45/M	R 2 2 L 2 2	3 2 4	R 2 2 L 2 2	R 0 L 0
141.	606/13 102/13	Thattarmadam	33/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
142.	608/13 48/13	Kalugumalai	36/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
143.	612/13 122/13	Cheranmahadevi	74/M	R 3 2 L 3 2	3 2 4	R 2 3 L 3 3	R 0 L 0
144.	617/13 531/13	TIN junction	45/M	R 0 2 L 0 2	1 0 2	R 0 0 L 0 0	R 0 L 0
145.	622/13 69/13	Moondradaipu	60/M	R 1 2 L 1 2	2 2 4	R 2 1 L 2 1	R 0 L 0

146.	623/13	TIN junction 532/13	59/M	R 1 2 L 1 2	2 2 4	R 2 0 L 2 0	R 0 L 0
147.	628/13	TIN town 450/13	76/F	R 2 3 L 2 3	3 2 4	R 2 2 L 2 2	R 0 L 0
148.	630/13	TIN Pettai 395/13	51/M	R 1 2 L 1 2	2 1 3	R 0 0 L 0 0	R 0 L 0
149.	634/13	Thiruvenkatam 87/13	30/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
150.	639/13	Cheranmahadevi 135/13	36/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
151.	640/13	Pettai 399/13	72/F	R 3 3 L 3 3	3 3 4	R 3 2 L 3 2	R 0 L 0
152.	643/13	Mukkudal 79/13	80/F	R 3 3 L 3 3	4 3 4	R 3 2 L 3 2	R 1 L 1
153.	644/13	Manur 172/13	68/M	R 3 2 L 3 2	2 2 4	R 0 0 L 0 0	R 0 L 0
154.	645/13	Thisayanvilai 130/13	70/M	R 3 4 L 3 4	4 4 4	R 3 3 L 3 3	R 1 L 1
155.	649/13	Eppothum Vendran 43/13	58/M	R 2 2 L 2 2	2 1 3	R 2 0 L 2 0	R 0 L 0
156.	650/13	Alwar Thirunagari 77/13	40/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
157.	651/13	Kalakkad 165/13	60/M	R 1 2 L 1 2	2 1 3	R 2 0 L 2 0	R 0 L 0
158.	653/13	Sankarankovil Town 197/13	46/M	R 0 1 L 0 1	2 0 2	R 0 0 L 0 0	R 0 L 0
159.	655/13	Valliyoor 210/13	45/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
160.	662/13	Palaiyankottai	53/M	R 0 0	0 0 0	R 0 0	R 0

		424/13		L 0 0		L 0 0	L 0
161.	663/13	TIN City TIW 148/13	80/F	R 0 0 L 0 0	2 2 3	R 2 1 L 2 1	R 1 L 1
162.	664/13	Vijaya Narayanam 535/13	38/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
163.	669/13	Veeravanalloor 150/13	34/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
164.	670/13	Muneerpallam 219/13	32/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
165.	672/13	Palaiyankottai 435/13	49/F	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
166.	673/13	Nathampatti 80/13	42/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
167.	676/13	TIN railway 95/13	65/M	R 2 2 L 2 2	2 1 4	R 2 1 L 2 1	R 0 L 0
168.	677/13	Thirukurangudi 73/13	40/M	R 0 0 L 0 0	1 0 1	R 0 0 L 0 0	R 0 L 0
169.	678/13	Sivagiri 145/13	66/M	R 2 2 L 2 2	1 1 3	R 2 1 L 2 1	R 0 L 0
170.	679/13	Sivagiri 146/13	47/F	R 0 0 L 0 0	1 0 2	R 0 0 L 0 0	R 0 L 0
171.	682/13	Gangaikondan 94/13	60/M	R 2 1 L 2 1	2 2 3	R 2 1 L 2 1	R 0 L 0
172.	683/13	Gangaikondan 94/13	38/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
173.	686/13	Moolakaraipatti 61/13	55/M	R 2 1 L 2 1	2 2 4	R 3 2 L 3 2	R 0 L 0
174.	690/13	Thatchanallur 269/13	38/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0

175.	691/13	TIN Taluk 160/13	59/M	R 2 2 L 2 2	3 2 4	R 2 2 L 2 2	R 0 L 0
176.	692/13	Alwarkurichi 161/13	65/M	R 2 2 L 2 2	3 2 4	R 2 1 L 2 1	R 0 L 0
177.	694/13	Achanputhur 68/13	58/M	R 2 1 L 2 1	2 1 3	R 2 0 L 2 0	R 1 L 1
178.	695/13	Palaiyankottai 448/13	54/M	R 2 1 L 2 1	2 1 3	R 2 0 L 2 0	R 0 L 0
179.	696/13	Kovilpatti East 283/13	31/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
180.	697/13	TIN junction 620/13	70/F	R 3 3 L 3 3	3 3 4	R 3 2 L 3 2	R 0 L 0
181.	698/13	Manur 198/13	32/M	R 0 0 L 0 0	0 0 1	0 0 L 0 0	R 0 L 0
182.	699/13	Manur 203/13	32/M	R 0 0 L 0 0	1 0 2	R 0 0 L 0 0	R 0 L 0
183.	702/13	Kovilpatti West 224/13	38/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
184.	704/13	Perumalpuram 306/13	43/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
185.	705/13	Palaiyankottai 473/13	55/M	R 2 1 L 2 1	2 1 3	R 1 0 L 1 0	R 0 L 0
186.	706/13	TIN junction 629/13	45/M	R 1 0 L 1 0	1 0 2	R 0 0 L 0 0	R 0 L 0
187.	708/13	Palaiyankottai 474/13	36/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
188.	709/13	Gangaikondan 95/13	70/M	R 3 3 L 3 3	3 2 4	R 3 2 L 3 2	R 0 L 0
189.	710/13	Thatchanallur	70/M	R 3 2	2 2 4	R 2 2	R 0

		276/13		L 3 2		L 2 2	L 0
190.	711/13	Sankarankovil Town 219/13	65/M	R 2 2 L 2 2	2 2 3	R 2 2 L 2 2	R 0 L 0
191.	712/13	Pappagudi 77/13	51/M	R 0 1 L 0 1	1 1 2	R 2 0 L 2 0	R 0 L 0
192.	714/13	Ervadi 122/13	57/M	R 2 1 L 2 1	1 1 3	R 1 0 L 1 0	R 0 L 0
193.	715/13	Gangaikondan 96/13	40/M	R 0 0 L 0 0	1 0 2	R 0 0 L 0 0	R 0 L 0
194.	717/13	Palaiyankottai 482/13	49/M	R 0 2 L 0 2	3 1 2	R 0 0 L 0 0	R 0 L 0
195.	718/13	Thirukurungudi 77/13	58/F	R 1 2 L 1 2	2 1 3	R 2 0 L 2 0	R 0 L 0
196.	719/13	S.V. Karai 95/13	70/M	R 2 3 L 2 3	2 2 3	R 2 2 L 2 2	R 0 L 0
197.	720/13	Suthamalli 33/13	33/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
198.	729/13	Vijaya Narayanam 70/13	35/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
199.	748/13	Manur 228/13	50/M	R 0 2 L 0 2	2 0 3	R 0 0 L 0 0	R 0 L 0
200.	749/13	Moondradaippu 79/13	45/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
201.	806/13	Alangulam 324/13	30/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
202.	807/13	Alangulam 324/13	30/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
203.	827/13	TIN TIW 182/13	47/M	R 0 0 L 0 0	4 4 4	R 0 0 L 0 0	R 0 L 0

204.	829/13 116/13	Puliyampatti	65/M	R 2 2 L 2 2	2 2 4	R 2 2 L 2 2	R 0 L 0
205.	831/13 190/13	Thalaiyuthu	65/M	R 2 3 L 2 3	2 2 3	R 2 2 L 2 2	R 0 L 0
206.	833/13 230/13	Kadayanallur	60/F	R 2 3 L 2 3	1 3 4	R 2 1 L 2 1	R 0 L 0
207.	834/13 468/13	Melapalayam	31/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
208.	837/13 823/13	TIN junction	35/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
209.	846/13 193/13	TIN TIW	75/M	R 3 3 L 3 3	3 2 4	R 2 3 L 2 3	R 1 L 1
210.	866/13 96/13	Thirukkurungudi	31/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
211.	880/13 421/13	Kovilpatti W	62/M	R 1 2 L 1 2	2 2 3	R 1 1 L 1 1	R 0 L 0
212.	884/13 325/13	Muneerpallam	35/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
213.	890/13 284/13	Panagudi	45/F	R 1 2 L 1 2	1 1 3	R 0 0 L 0 0	R 0 L 0
214.	892/13 257/13	Paavoor Chathiram	61/M	R 2 2 L 2 2	2 1 4	R 2 0 L 2 0	R 0 L 0
215.	893/13 361/13	Alangulam	70/M	R 3 3 L 3 3	3 3 4	R 3 3 L 3 3	R 0 L 0
216.	896/13 404/13	Thatchanallur	80/M	R 3 3 L 3 3	3 2 4	R 3 3 L 3 3	R 1 L 1
217.	897/13 886/13	TIN Town	33/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
218.	902/13 226/13	Thalaiyuthu	41/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0

219.	907/13 687/13	Pettai	32/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
220.	915/13 146/13	Gangaikondan	33/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
221.	929/13 67/13	Pasavanthanai	59/M	R 2 2 L 2 2	2 1 3	R 1 1 L 1 1	R 0 L 0
222.	933/13 153/13	Gangaikondan	36/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
223.	937/13 721/13	Palaiyankottai	40/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
224.	944/13 134/13	Thevarkulam	65/M	R 1 2 L 1 2	2 1 3	R 1 1 L 1 1	R 0 L 0
225.	952/13 127/13	TIN railway	50/M	R 2 2 L 2 2	2 2 4	R 2 2 L 2 2	R 1 L 1
226.	954/13 197/13	Eruvadi	41/M	R 0 1 L 0 1	0 0 0	R 0 0 L 0 0	R 0 L 0
227.	957/13 277/13	Kalakkad	65/F	R 1 1 L 1 1	1 1 2	R 1 1 L 1 1	R 0 L 0
228.	961/13 376/13	Alangulam	60/F	R 1 1 L 1 1	2 1 2	R 1 1 L 1 1	R 0 L 0
229.	976/13 275/13	Pavoorchathiram	40/M	R 0 0 L 0 0	1 0 1	R 0 0 L 0 0	R 0 L 0
230.	978/13 231/13	Veeravanallur	45/M	R 0 0 L 0 0	1 0 1	R 0 0 L 0 0	R 0 L 0
231.	981/13 144/13	Mukkudal	30/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
232.	985/13 145/13	Mukkudal	53/M	R 1 1 L 1 1	1 1 2	R 1 1 L 1 1	R 0 L 0
233.	988/13	Palaiyamkottai	36/M	R 0 0	0 0 1	R 0 0	R 0

		753/13		L 0 0		L 0 0	L 0
234.	991/13	Veeravanallur 234/13	35/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
235.	997/13	Sucindiram 413/13	50/F	R 1 1 L 1 1	1 1 1	R 0 0 L 0 0	R 0 L 0
236.	1015/13	Perumalpuram (Convict) 507/13	41/M	R 0 1 L 0 1	0 0 1	R 0 0 L 0 0	R 0 L 0
237.	1022/13	Uthumalai 162/13	30/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
238.	1029/13	Cheranmahadevi 229/13	54/F	R 1 2 L 1 2	2 1 3	R 0 0 L 0 0	R 0 L 0
239.	1030/13	TvMCH 265/13	60/M	R 3 3 L 3 3	2 2 4	R 1 1 L 1 1	R 0 L 0
240.	1032/13	Muneerpallam 389/13	70/M	R 2 3 L 2 3	3 3 4	R 2 2 L 2 2	R 0 L 0
241.	1034/13	Nanguneri 226/13	33/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
242.	1040/13	TIN Junction 1174/13	33/M	R 1 1 L 1 1	1 1 1	R 0 2 L 0 1	R 0 L 0
243.	1046/13	Suthamalli 221/13	60/M	R 2 3 L 2 3	1 1 1	R 1 1 L 1 1	R 0 L 0
244.	1048/13	Perumalpuram 517/13	65/F	R 2 2 L 2 2	2 2 3	R 2 2 L 2 2	R 0 L 0
245.	1053/13	Panavadalichathiram 115/13	52/F	R 0 2 L 0 2	1 0 1	R 0 0 L 0 0	R 0 L 0
246.	1055/13	Kallidaikurichi 312/13	47/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
247.	1056/13	Moondradaippu 113/13	45/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0

248.	1059/13	Ambasamudram 242/13	75/F	R 2 2 L 2 2	3 2 4	R 2 2 L 2 2	R 0 L 0
249.	1061/13	Kalakkad 306/13	50/M	R 1 1 L 1 1	1 1 1	R 0 0 L 0 0	R 0 L 0
250.	1062/13	Manur 333/13	70/M	R 2 3 L 2 3	3 3 4	R 2 2 L 2 2	R 1 L 1
251.	1066/13	Alwarkurichi 254/13	45/M	R 0 1 L 0 1	0 0 1	R 0 0 L 0 0	R 0 L 0
252.	1068/13	Palaiyankottai 795/13	47/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
253.	1077/13	Seidunganallur 126/13	45/M	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
254.	1079/13	TIN Pettai 794/13	39/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
255.	1084/13	S. V. Karai 159/13	46/M	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
256.	1085/13	Thisayanvilai 283/13	45/M	R 0 0 L 0 0	1 0 1	R 0 0 L 0 0	R 0 L 0
257.	1088/13	Seidunganallur 129/13	38/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
258.	1091/13	Alwarkurichi 257/13	36/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
259.	1093/13	Nanguneri 234/13	48/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
260.	1094/13	TIN railway 138/13	48/M	R 1 2 L 1 2	1 0 1	R 0 0 L 0 0	R 0 L 0
261.	1097/13	Sivanthipatti 60/13	58/M	R 1 2 L 1 2	1 1 2	R 1 0 L 1 0	R 0 L 0
262.	1098/13	Pettai 81/13	65/M	R 1 1 L 1 1	1 1 2	R 1 1 L 1 1	R 1 L 1

263.	1099/13	Murappanadu 226/13	80/F	R 2 3 L 2 3	3 3 4	R 2 2 L 2 2	R 2 L 2
264.	1100/13	Murappanadu 227/13	65/M	R 1 1 L 1 1	1 1 2	R 1 0 L 1 0	R 0 L 0
265.	1101/13	Palaiyankottai 823/13	50/M	R 0 0 L 0 0	1 0 1	R 0 0 L 0 0	R 0 L 0
266.	1102/13	Kallidaikurichi 326/13	60/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
267.	1103/13	TIN Junction 1270/13	55/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
268.	1108/13	Veeravanallur 258/13	38/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
269.	1109/13	TIN Taluk 281/13	60/M	R 1 2 L 1 2	2 2 4	R 1 0 L 1 0	R 0 L 0
270.	1111/13	Murappanadu 229/13	50/F	R 1 1 L 1 1	1 1 1	R 0 0 L 0 0	R 0 L 0
271.	1112/13	Murappanadu 229/13	80/F	R 3 3 L 3 3	3 3 3	R 2 1 L 2 1	R 1 L 1
272.	1113/13	Thisayanvilai 296/13	55/M	R 1 1 L 1 1	1 1 2	R 1 0 L 1 0	R 0 L 0
273.	1117/13	Thisayanvilai 298/13	72/F	R 2 2 L 2 2	2 2 3	R 1 1 L 1 1	R 0 L 0
274.	1118/13	Thisayanvilai 299/13	55/F	R 1 1 L 1 1	0 1 2	R 1 0 L 1 0	R 0 L 0
275.	1120/13	Palaiyankottai 852/13	65/M	R 1 2 L 1 2	2 2 4	R 1 1 L 1 1	R 0 L 0
276.	1378/13	Manur 412/13	55/F	R 0 0 L 0 0	0 0 2	R 1 0 L 1 0	R 0 L 0
277.	1390/13	Moolakaraipatti	56/M	R 0 0	1 0 2	R 0 0	R 0

		151/13		L 0 0		L 0 0	L 0
278.	1408/13	Moolakaraipatti 152/13	45/M	R 0 0 L 0 0	0 1 1	R 0 0 L 0 0	R 0 L 0
279.	1415/13	Ervadi 266/13	50/M	R 0 0 L 0 0	2 0 2	R 2 1 L 2 1	R 0 L 0
280.	1426/13	Thisayanvilai 341/13	48/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
281.	1438/13	Alwarthirunagari 202/13	65/F	R 1 2 L 1 2	2 2 3	R 1 1 L 1 1	R 0 L 0
282.	1453/13	Nalatinputhur 201/13	55/M	R 0 1 L 0 1	1 0 1	R 0 1 L 0 1	R 0 L 0
283.	1471/13	Perumalpuram 688/13 (Convict)	47/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
284.	1486/13	Moontradaippu 150/13	48/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
285.	1499/13	TIN Town 1395/13	38/F	R 0 0 L 0 0	0 0 0	R 0 3 L 0 1	R 0 L 0
286.	1504/13	TIN Town 1400/13	40/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
287.	1506/13	Appainayakkan Patti 143/13	30/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
288.	1512/13	TIN junction 1484/13	54/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
289.	1516/13	Pettai 1034/13	30/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
290.	1523/13	Palaiyankottai 1065/13	62/F	R 1 2 L 1 2	1 0 2	R 1 1 L 1 1	R 0 L 0
291.	1536/13	TvMCH 355/13	70/M	R 2 2 L 2 2	2 2 4	R 2 2 L 2 2	R 1 L 1

292.	1539/13	Puliyangudi 491/13	78/M	R 2 3 L 2 3	2 2 3	R 2 2 L 2 2	R 0 L 0
293.	1549/13	Pettai 1041/13	50/F	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
294.	1556/13	Sivagiri 351/13	80/M	R 2 2 L 2 2	4 4 4	R 2 1 L 2 1	R 1 L 1
295.	1569/13	Thirukurungudi 169/13	35/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
296.	1570/13	TIN Junction 1508/13	35/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
297.	1573/13	Murappanadu 325/13	40/M	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
298.	1639/13	Thisayanvilai 383/13	55/M	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
299.	1648/13	Gangaikondan 245/13	36/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
300.	1660/14	TIN Taluk 392/13	55/M	R 1 1 L 1 1	1 1 2	R 1 0 L 1 0	R 0 L 0
301.	1664/13	TIN TIW 386/13	80/F	R 1 2 L 1 2	3 4 4	R 3 2 L 3 2	R 2 L 2
302.	1668/13	Kovilpatti East 1234/13	45/M	R 0 0 L 0 0	1 1 2	R 0 0 L 0 0	R 0 L 0
303.	1680/13	Elayirampannai 285/13	39/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
304.	25/14	Nazareth 7/14	39/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
305.	27/14	TIN TIW city 7/14	60/F	R 2 2 L 2 2	2 1 1	R 2 1 L 2 2	R 0 L 0
306.	88/14 (Met)	Pettai 86/14	50/F	R 1 0 L 1 0	1 0 1	R 0 0 L 0 0	R 0 L 0

307.	89/14	Murappanadu 19/14	40/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
308.	96/14	Alangulam 27/14	32/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
309.	100/14	Eruvadi 17/14	55/F	R 1 2 L 1 2	3 3 3	R 1 0 L 1 0	R 0 L 0
310.	106/14	TIN Taluk 19/14	34/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
311.	109/14	Ambasamudram 18/14	43/F	R 1 1 L 1 1	3 0 3	R 0 0 L 0 0	R 0 L 0
312.	110/14	Nanguneri 19/14	40/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
313.	119/14	Cherakulam 5/14	32/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
314.	130/14	Palaiyankottai 57/14	67/M	R 1 1 L 1 1	1 1 1	R 1 1 L 1 1	R 0 L 0
315.	138/14	Tirunelveli Town 106/14	44/M	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
316.	143/14	Murappanadu 22/14	60/M	R 1 2 L 1 2	2 2 3	R 1 1 L 1 1	R 1 L 1
317.	149/14	Seidunganallur 36/14	70/F	R 1 2 L 1 2	2 2 3	R 1 1 L 1 1	R 0 L 0
318.	154/14	Palaiyankottai 73/14	57/F	R 1 1 L 1 1	1 1 2	R 1 0 L 1 0	R 0 L 0
319.	155/14	TIN Taluk 24/14	38/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
320.	164/14	Alangulam 40/14	40/F	R 0 0 L 0 0	1 0 1	R 0 0 L 0 0	R 0 L 0
321.	205/14	Eruvadi	65/M	R 0 0	3 3 4	R 2 1	R 0

	Met	34/14		L 0 0		L 2 1	L 0
322.	213/14	Thirukkurungudi 21/14	47/M	R 0 0 L 0 0	1 0 1	R 0 0 L 0 0	R 0 L 0
323.	247/14	Puliyampatti 25/14	47/M	R 3 2 L 3 2	3 3 3	R 0 0 L 0 0	R 0 L 0
324.	248/14	KR Raman 25/14	67/M	R 4 4 L 4 4	2 2 3	R 2 2 L 2 2	R 0 L 0
325.	262/14 (SB)	Kalugumalai 23/14	30/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
326.	285/14	TIN Taluk 58/14	71/M	R 2 3 L 2 3	3 3 4	R 3 3 L 3 3	R 2 L 2
327.	294/14	Eruvadi 48/14	54/M	R 0 1 L 0 1	1 1 1	R 1 0 L 1 0	R 0 L 0
328.	310/14	Uvari 28/14	34/M	R 1 1 L 1 1	1 1 1	R 0 0 L 0 0	R 0 L 0
329.	315/14	Sernthamaram 87/14	45/F	R 3 1 L 3 1	2 0 3	R 0 0 L 0 0	R 0 L 0
330.	318/14	Nanguneri 59/14	38/F	R 1 1 L 1 1	1 1 1	R 3 1 L 2 1	R 0 L 0
331.	322/14	Veeravanallur 70/14	40/M	R 0 0 L 0 0	0 1 1	R 0 0 L 0 0	R 0 L 0
332.	324/14	Palaiyankottai 192/14	47/M	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
333.	328/14	TIN Town 243/14	45/M	R 0 2 L 0 2	1 0 2	R 0 0 L 0 0	R 0 L 0
334.	333/14	Puliyampatti 37/14	40/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
335.	337/14	Sivalaperi 47/14	45/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0

336.	339/14	Melapalayam 199/14	45/F	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
337.	349/14	Suthamalli 76/14	38/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
338.	352/14	Melapalayam 210/14	32/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
339.	358/14	Cherakulam 19/14	80/M	R 2 2 L 2 2	3 3 4	R 2 2 L 2 2	R 2 L 2
340.	378/14	Palaiyankottai 263/14	31/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
341.	411/14	Melapalayam 234/14	75/M	R 2 3 L 2 3	4 4 4	R 2 2 L 2 2	R 0 L 0
342.	423/14	Kadambur 42/14	49/F	R 1 0 L 1 0	1 0 1	R 0 0 L 0 0	R 0 L 0
343.	435/14	Tirunelveli Town 332/14	36/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
344.	451/14	TvMCH 112/14	43/F	R 1 1 L 1 1	1 0 1	R 0 0 L 0 0	R 0 L 0
345.	456/14	Perumalpuram 202/14	75/M	R 2 0 L 1 0	3 3 4	R 3 3 L 3 2	R 1 L 1
346.	457/14	Kalakkad 160/14	45/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
347.	463/14	Tiruchendur Temple 114/14	60/M	R 1 0 L 1 0	2 1 3	R 1 0 L 1 0	R 0 L 0
348.	488/14	Vembakottai 151/14	49/M	R 0 2 L 0 2	1 1 2	R 0 0 L 0 0	R 0 L 0
349.	491/14	Sankarankovil 300/14	72/M	R 1 3 L 1 1	1 2 2	R 2 2 L 2 2	R 0 L 0
350.	497/14	Veeravanallur 113/14	40/M	R 1 1 L 1 1	1 0 1	R 0 0 L 0 0	R 0 L 0

351.	502/14	Suthamalli 97/14	46/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
352.	507/14	Veeravanallur 115/14	80/M	R 2 2 L 2 2	2 2 4	R 2 2 L 2 2	R 1 L 1
353.	509/14	Thisayanvilai 142/14	55/M	R 2 2 L 2 2	2 1 2	R 1 1 L 1 1	R 0 L 0
354.	518/14	Thiruvenkatam 138/14	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
355.	530/14 (SB)	TIN junction 415/14	32/M	R 2 2 L 2 2	4 4 4	R 0 0 L 0 0	R 0 L 0
356.	536/14	Moontradaippu 75/14	49/M	R 2 1 L 2 1	1 1 1	R 0 0 L 0 0	R 0 L 0
357.	551/14	Suthamalli 103/14	45/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
358.	555/14	Palaiyankottai 290/14	37/M	R 1 1 L 1 1	2 2 4	R 1 0 L 0 0	R 0 L 0
359.	563/14	Pettai 359/14	39/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
360.	567/14	Manur 138/14	70/M	R 2 2 L 2 2	3 3 4	R 2 2 L 2 2	R 0 L 0
361.	568/14	Pasuvanthanai 67/14	35/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
362.	572/14	Tenkasi 199/14	70/M	3 3 L 3 3	2 2 3	R 3 3 L 3 3	R 0 L 0
363.	578/14	Murappanadu 102/14	40/M	R 1 1 L 1 1	1 0 1	R 0 0 L 0 0	R 0 L 0
364.	580/14	Valliyoor 222/14	47/M	R 1 1 L 1 1	1 0 1	R 0 0 L 0 0	R 0 L 0
365.	595/14	Thatchanallur	45/F	R 0 1	0 0 1	R 0 0	R 0

		261/14		L 0 1		L 0 0	L 0
366.	599/14	TIN Railway 36/14	48/M	R 0 2 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
367.	600/14	Tenkasi 194/14	57/F	R 2 2 L 2 2	2 1 2	R 1 0 L 1 0	R 0 L 0
368.	601/14 (SB)	Veeravanallur 132/14	70/M	R 1 1 L 1 1	1 1 2	R 1 1 L 1 1	R 0 L 0
369.	603/14	Alangulam 244/14	47/F	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
370.	606/14	Manur 210/14	37/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
371.	608/14	Thatchanallur 266/14	40/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
372.	611/14	Srivaikundam 227/14	48/F	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
373.	615/14	Cheranmadevi 88/14	35/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
374.	617/14	Puliyangudi 246/14	65/F	R 2 3 L 2 3	3 3 4	R 2 2 L 2 2	R 1 L 1
375.	620/14	Pettai 382/14	38/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
376.	621/14	Elathur 117/14	80/M	R 2 2 L 2 2	2 2 3	R 2 2 L 2 2	R 2 L 2
377.	622/14	VK Puram 132/14	64/M	R 2 2 L 2 2	2 2 2	R 2 1 L 2 1	R 0 L 0
378.	627/14	Palaiyankottai 387/14	59/M	R 1 2 L 1 2	1 0 1	R 1 0 L 1 0	R 0 L 0
379.	642/14	Valliyoor 237/14	50/F	R 0 1 L 0 1	2 0 2	R 0 0 L 0 0	R 0 L 0

380.	643/14 90/14	Moolakaraipatti	76/M	R 2 2 L 2 2	2 2 3	R 2 2 L 2 2	R 1 L 1
381.	646/14 157/14	KV Nallur	80/F	R 3 4 L 3 4	4 3 4	R 3 3 L 3 3	R 3 L 3
382.	647/14 395/14	Pettai	40/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
383.	649/14 396/14	Pettai	36/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
384.	652/14 125/14	Devarkulam	65/M	R 2 2 L 2 2	2 1 3	R 1 1 L 1 1	R 0 L 0
385.	655/14 193/14	Alwarthirunagari	53/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
386.	659/14 622/14	Themala	57/F	R 1 1 L 1 1	1 2 3	R 1 0 L 1 0	R 0 L 0
387.	665/14 502/14	TIN Junction	38/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
388.	667/14 503/14	TIN Junction	41/F	R 0 1 L 0 1	0 0 1	R 0 0 L 0 0	R 0 L 0
389.	668/14 115/14	Suthamalli	41/M	R 3 3 L 3 3	3 3 3	R 0 0 L 0 0	R 0 L 0
390.	669/14 198/14	Kalakkad	37/M	R 1 0 L 1 0	1 0 1	R 0 0 L 0 0	R 0 L 0
391.	670/14 264/14	Alangulam	45/M	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
392.	673/14 401/14	Pettai	61/M	R 2 3 L 2 3	2 1 3	R 1 1 L 1 1	R 0 L 0
393.	677/14 143/14	Veeravanallur	40/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
394.	680/14 67/14	Sivanthipatti	55/F	R 1 1 L 1 1	1 1 2	R 1 0 L 1 0	R 0 L 0

395.	681/14	Manur 233/14	50/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
396.	691/14	Perumalpuram 268/14	45/M	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
397.	692/14	Devarkulam 128/14	65/M	R 2 2 L 2 2	2 1 2	R 1 1 L 1 1	R 0 L 0
398.	693/14	Thiruvenkatam 169/14	46/F	R 1 1 L 1 1	1 0 1	R 0 0 L 0 0	R 0 L 0
399.	695/14	Perumalpuram 270/14	46/F	R 1 0 L 1 0	1 0 1	R 0 0 L 0 0	R 0 L 0
400.	697/14	TIN TIW City 173/14	46/F	R 1 1 L 1 1	1 0 1	R 0 0 L 0 0	R 0 L 0
401.	699/14	Pettai 411/14	45/F	R 1 1 L 1 1	1 0 1	R 0 0 L 0 0	R 0 L 0
402.	700/14	Thatchanallur 303/14	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
403.	740/14	Rajapalayam South 352/14	71/M	R 0 0 L 0 0	0 0 1	R 1 1 L 1 1	R 0 L 0
404.	746/14	Alangulam 283/14	69/M	R 1 1 L 1 1	2 2 2	R 2 2 L 2 2	R 0 L 0
405.	749/14	Sankarankoil Taluk 140/14	48/F	R 1 1 L 1 1	0 0 1	R 0 0 L 0 0	R 0 L 0
406.	750/14	Kovilpatti 705/14	54/M	R 1 2 L 1 2	1 0 1	R 1 0 L 1 0	R 0 L 0
407.	751/14	Moolakaraipatti 99/14	55/M	R 1 2 L 1 2	1 0 1	R 1 0 L 1 0	R 0 L 0
408.	753/14	Valliyoor 272/14	55/M	R 1 1 L 1 1	1 1 1	R 1 1 L 1 1	R 0 L 0
409.	754/14	Moontradaippu	39/M	R 0 0	0 0 1	R 0 0	R 0

		93/14		L 0 0		L 0 0	L 0
410.	756/14	alliyoor 266/14	55/M	R 2 2 L 2 2	2 0 2	R 2 0 L 2 0	R 0 L 0
411.	758/14	Thisayanvilai 206/14	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
412.	759/14	Kuruvikulam 126/14	38/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
413.	760/14	Thalaiyuthu 203/14	42/M	R 0 1 L 0 1	0 0 2	R 0 0 L 0 0	R 0 L 0
414.	761/14	Sernthamaram 173/14	58/M	R 2 2 L 2 2	2 1 3	R 2 0 L 2 0	R 0 L 0
415.	762/14	Talavaipuram 312/14	37/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
416.	765/14	Thalaiyuthu 207/14	38/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
417.	771/14	Ettayapuram 105/14	70/F	R 3 3 L 3 3	3 3 4	R 2 2 L 2 2	R 0 L 0
418.	773/14	Alangulam 295/14	42/M	R 1 1 L 1 1	1 2 2	R 1 0 L 1 0	R 0 L 0
419.	775/14	Seidunganallur 180/14	76/F	R 3 3 L 3 3	3 3 4	R 3 2 L 3 2	R 1 L 1
420.	776/14	Tenkasi 246/14 (Metopism)	60/M	R 1 2 L 1 2	2 1 2	R 1 0 L 1 0	R 0 L 0
421.	777/14	Manur 249/14	36/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
422.	778/14	Kuruvikulam 132/14	32/M	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
423.	785/14	Puliyarai 59/14	70/F	R 3 3 L 3 3	3 3 3	R 2 2 L 2 2	R 0 L 0

424.	786/14	Manur 250/14	45/M	R 0 1 L 0 1	1 0 1	R 0 0 L 0 0	R 0 L 0
425.	788/14	Kallidaikurichi 186/14	40/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
426.	791/14	TIN junction 549/14	52/M	R 1 2 L 1 2	2 3 4	R 0 0 L 0 0	R 0 L 0
427.	792/14	TIN junction 545/14 (Receding)	32/M	R 2 2 L 2 2	1 0 1	R 0 0 L 0 0	R 0 L 0
428.	794/14	Gangaikondan 129/14	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
429.	795/14	Perumalpuram 284/14	69/M	R 1 1 L 1 1	1 1 3	R 1 1 L 1 1	R 0 L 0
430.	797/14	Thisayanvilai 213/14	35/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
431.	801/14	Rajapalayam North 319/14	34/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
432.	805/14	Perumalpuram 292/14	36/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
433.	813/14	Kalakkad 224/14	35/M	R 2 2 L 2 2	3 0 3	R 0 0 L 0 0	R 0 L 0
434.	814/14	Perumalpuram 298/14	42/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
435.	816/14	Perumalpuram 299/14	49/F	R 0 2 L 0 2	1 0 2	R 0 0 L 0 0	R 0 L 0
436.	823/14	Melapalayam 362/14	55/M	R 2 3 L 2 3	2 2 3	R 2 0 L 2 0	R 0 L 0
437.	824/14	Suthamalli 139/14	56/F	R 2 3 L 2 3	3 2 3	R 2 0 L 2 0	R 0 L 0
438.	828/14	TIN Junction 577/14	45/M	R 0 2 L 0 2	1 0 1	R 0 0 L 0 0	R 0 L 0

439.	831/14	(Healed depressed) Kovilpatti East 758/14	34/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
440.	835/14	Kadayam 228/14	46/F	R 0 2 L 0 2	1 0 2	R 0 0 L 0 0	R 0 L 0
441.	841/14	Sankarankovil Town 450/14	45/M	R 0 3 L 0 3	2 0 3	R 0 0 L 0 0	R 0 L 0
442.	842/14	Manur 273/14	33/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
443.	843/14	VK Puram 174/14	58/F	R 3 3 L 3 3	3 3 4	R 2 0 L 2 0	R 0 L 0
444.	845/14	Suthamalli 145/14	65/M	R 3 3 L 3 3	3 3 4	R 2 1 L 2 1	R 0 L 0
445.	846/14	Palaiyankottai 479/14	40/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
446.	847/14	Srivaikundam 257/14	75/M	R 3 3 L 3 3	3 3 4	R 2 2 L 2 2	R 0 L 0
447.	849/14	Mukkudal 167/14	35/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
448.	854/14	Rajapalayam N 342/14	39/M	R 0 0 L 0 0	0 0 3	R 0 0 L 0 0	R 0 L 0
449.	857/14	Ayikudi 104/14	32/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
450.	862/14	TIN Junction 589/14	52/M	R 2 2 L 2 2	1 1 3	R 1 0 L 1 0	R 0 L 0
451.	865/14	Palaiyankottai 492/14	45/M	R 0 2 L 0 2	2 0 2	R 0 0 L 0 0	R 0 L 0
452.	866/14	Thalaiyuthu 243/14	36/F	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
453.	868/14	TIW, TIN city	54/M	R 2 3	2 2 4	R 2 0	R 0

		205/14		L 2 3		L 2 0	L 0
454.	870/14	Kovilpatti West 728/14	47/M	R 2 2 L 2 2	1 0 2	R 0 0 L 0 0	R 0 L 0
455.	871/14	Kovilpatti East 768/14	60/M	R 3 3 L 3 3	3 3 4	R 2 0 L 2 0	R 0 L 0
456.	873/14	TIN TIW 209/14	56/F	R 2 3 L 2 3	2 1 3	R 2 1 L 2 1	R 0 L 0
457.	874/14	Palaiyankottai 502/14	40/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
458.	877/14	Veeravanallur 173/14	38/M	0 0 L 0 0	0 0 3	R 0 0 L 0 0	R 0 L 0
459.	879/14	Alwarkuruchi 154/14	60/F	R 3 3 L 3 3	3 3 4	R 3 3 L 3 3	R 2 L 2
460.	881/14	Rajapalayam South 410/14	35/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
461.	882/14	Seidunganallur 214/14	35/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
462.	884/14	Palaiyankottai 507/14	68/F	R 4 4 L 3 4	3 3 3	R 3 3 L 3 3	R 2 L 2
463.	885/14	Seidunganallur 215/14	35/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
464.	889/14	Manur 279/14	55/M	R 2 3 L 2 3	2 1 3	R 1 0 L 1 0	R 0 L 0
465.	890/14	Tiruchendur 306/14	46/F	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
466.	891/14	TIN Town 548/14	45/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
467.	892/14	Vembakottai 243/14	40/M	R 0 1 L 0 1	0 0 2	R 0 0 L 0 0	R 0 L 0

468.	893/14 239/14	Muneerpallam	80/M	R 3 3 L 3 3	3 3 3	R 2 2 L 2 2	R 1 L 1
469.	898/14 140/14	Nanguneri	74/M	R 2 3 L 2 3	2 1 3	R 2 1 L 2 1	R 0 L 0
470.	899/14 281/14	Manur	70/M	R 3 3 L 3 3	2 2 3	R 2 2 L 2 2	R 0 L 0
471.	917/14 571/14	TIN Town	40/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
472.	919/14 525/14	Palaiyankottai	50/F	R 0 0 L 0 0	2 0 2	R 0 0 L 0 0	R 0 L 0
473.	921/14 71/14	Uvari	37/M	R 2 2 L 2 2	2 3 3	R 1 0 L 1 0	R 0 L 0
474.	922/14 192/14	VK Puram	33/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
475.	927/14 419/14	Melapalayam	70/F	R 2 3 L 2 3	2 2 2	R 2 1 L 2 1	R 0 L 0
476.	936/14 219/14	Seidunganallur	66/M	R 2 2 L 2 2	3 3 4	R 1 1 L 1 1	R 1 L 1
477.	945/14 220/14	TIN Taluk	60/M	R 1 2 L 1 2	2 1 2	R 1 0 L 1 0	R 0 L 0
478.	946/14 374/14	Thatchanallur	56/F	R 1 1 L 1 1	1 1 2	R 1 0 L 1 0	R 0 L 0
479.	950/14 4/14	Melapalayam	45/M	R 0 1 L 0 1	1 0 2	R 0 0 L 0 0	R 0 L 0
480.	955/14 224/14	Kallidaikurichi	60/F	R 2 3 L 2 3	2 2 4	R 2 1 L 2 1	R 0 L 0
481.	956/14 260/14	Vembakottai	30/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
482.	960/14 124/14	Cheranmadevi	53/F	R 0 2 L 0 2	1 0 2	R 1 0 L 1 0	R 0 L 0

483.	968/14 172/14	Chokkampatti	38/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
484.	970/14 252/14	Kalakkad	47/M	R 0 1 L 0 1	1 0 3	R 0 0 L 0 0	R 0 L 0
485.	972/14 259/14	Kadayam	31/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
486.	973/14 379/14	Thatchanallur	52/M	R 2 2 L 2 2	2 0 2	R 0 0 L 0 0	R 0 L 0
487.	975/14 269/14	Paavorchathiram	30/F	R 0 0 L 0 0	0 0 0	R 0 0 L 0 0	R 0 L 0
488.	978/14 187/14	Uthumalai	32/F	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
489.	979/14 166/14	Alwarkurichi	38/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
490.	983/14 251/14	Muneerpallam	30/M	R 0 0 L 0 0	0 0 1	R 0 0 L 0 0	R 0 L 0
491.	986/14 547/14	Palaiyankottai	36/M	R 0 0 L 0 0	0 0 3	R 0 0 L 0 0	R 0 L 0
492.	988/14 601/14	Tirunelveli Town	45/M	R 0 1 L 0 1	1 0 3	R 0 0 L 0 0	R 0 L 0
493.	989/14 213/14	KV Nallur	50/M	R 0 1 L 0 1	2 1 3	R 0 0 L 0 0	R 0 L 0
494.	990/14 224/14	Tiruvengadam	55/M	R 2 2 L 2 2	2 2 3	R 2 0 L 2 0	R 0 L 0
495.	991/14 162/14	Kuruvikulam	30/M	R 0 0 L 0 0	0 0 2	R 0 0 L 0 0	R 0 L 0
496.	996/14 336/14	Perumalpuram	64/M	R 2 3 L 2 3	3 3 4	R 2 2 L 2 2	R 0 L 0
497.	1001/14	Thiruthangal	47/M	R 0 1	2 0 4	R 0 0	R 0

		438/14		L 0 1		L 0 0	L 0
498.	1004/14	Manur ////14	40/F	R 0 0 L 0 0	1 0 1	R 0 0 L 0 0	R 0 L 0
499.	1007/14	Puliyampatti 86/14	41/M	R 0 0 L 0 0	1 0 2	R 0 0 L 0 0	R 0 L 0
500.	1010/14	Nanguneri 152/14	65/M	R 3 3 L 3 3	3 3 3	R 2 2 L 2 2	R 0 L 0